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An Important Proposal

A committee of engineers, representing national and local professional engineering societies, recently submitted to the New York State Constitutional Convention, now in session, suggestions relating to changes in the State Constitution. The recommendations offered proposed the creation of a department of engineering and public works and a department of public utilities, both to be headed by commissioners appointed for long terms, among whom should be well qualified representatives of the engineering profession. These recommendations were offered in the belief that few functions of government are of greater importance than the administration of public works and the regulation of public utilities, both of which embrace great undertakings intimately connected with the prosperity, health and comfort of the people. Few will deny that the farther public works and public utilities are removed from the influence of politics the better for the community. The same might be said, however, with even greater emphasis, of the control of marine and shipping matters by the national government.

Oil Engines for Commercial Boats

The article which we publish elsewhere in this issue, on the use of oil engines, ought to attract more than passing attention. For years much has been published regarding marine Diesel engines, and many engines of this type, averaging over a thousand horsepower, have been installed. Some have operated successfully, while others have not come up to expectations and have been replaced by steam power. In general, judging by repeat orders, the four-cycle engine has been far more successful than any type of two-cycle engine thus far developed, in spite of the predictions made by well qualified engineers a few years ago. The manner in which the Diesel type of engine has been promoted by speculators need not concern us, but it is worth while to consider this type of engine from an engineering point of view.

Their very complicated mechanism cannot be denied, and that the excessively high-pressures and temperatures have led to troubles in operation goes without saying. Perhaps one of the most important considerations of all, however, has been the initial cost which, in most cases, has been far above the initial cost of steam plants of similar powers. Probably the high initial cost, together with the doubts of continued reliability and low cost of operation, has done more to prevent the general use of the Diesel type of engine than anything else.

In the engine described these objections seem to have been very largely overcome. The design is simple. Starting, reversing or stopping is apparently as easily accomplished as with an ordinary reciprocating engine, and, judging by the figures given, the economy of operation is exceptionally low. These factors, of course, are all important to the owners of small commercial boats. Generally speaking, the first cost of the steam plants for small commercial boats is in the neighborhood of $50 (£10 10s) per horsepower. In the case of the Diesel type of engine described, the initial cost is approximately the same, and, furthermore, a smaller operating force can be used, and the cost of fuel consumption as compared with coal for a steam plant is in the ratio of about 1 to 10.

With the foregoing in mind it seems that there is an excellent opportunity for the profitable operation of small commercial boats equipped with the Diesel type of engine from port to port, or from landing to landing, where the standby losses are an important consideration, provided the continued low cost of operation of the oil engines can be assured.

Emergency Generating Sets

The requirements of modern marine practice for emergency lighting and wireless service on board ship have brought about the development of a type of electric generating sets not hitherto required in the marine field. The necessity for providing a reliable source of electric energy by means of an independent plant isolated from the main power plant, and located well above the full-load waterline, has naturally led manufacturers to the adoption of internal combustion engine generating sets for this purpose. The use of internal combustion engine-driven sets on ship board involves no problems which have not already been satisfactorily solved, and, for the most part, the units are reliable, economical and well adapted for this service.

The installation of auxiliary sets, however, suggests

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the possibility of using such plants for other than purely emergency purposes. Where the generating capacity of the main plant in the engine room is only sufficient to meet the ordinary demands for electric current, any excess that may be temporarily needed can be supplied by the emergency set, thereby avoiding the subjection of the main power plant to overloads and their consequent dangers. By installing an emergency generating set of suitable capacity, additions to the original electrical equipment of the ship may be made without adding to the original plant, or, if the original plant consists of duplicate units, one generator could be replaced by an emergency set of suitable capacity, thereby lowering the first cost of the power plant and yet retaining all the features necessary for adequate electric service under both normal and emergency conditions.

From an engineering standpoint, there is no reason for limiting the service rendered by internal combustion engine-driven generating sets, as such units are now so carefully designed that their economy is very satisfactory and a high thermal efficiency can be maintained at partial loads as well as at full load. Under normal conditions there is no difficulty in inter-connecting the main and the emergency sets so that the operation of motors, lights and wireless outfit can be secured either from the main or emergency sets, or from both.

The Classing of American Vessels

A letter from one of the most prominent men in the shipbuilding business in the United States compliments INTERNATIONAL MARINE ENGINEERING on the stand it has taken on the subject of classing vessels built with American money in American shipyards. He writes: "I am very much of the opinion that we should do this very important work ourselves in this country, and, it seems to me, that the essential points to be borne in mind are that the administrative officers of such a society should have the confidence of the underwriters, the technical staff should have the confidence of the shipbuilders, and the rules should be up-to-date and scientific. . . . The reasons for classing our ships in the United States are manifold, but the principal ones with which I am concerned are the saving of time and the preventing of discrimination."

Recently contracts have been placed with American shipbuilders for over forty large vessels, and plans have already been passed for fifteen or more vessels which will undoubtedly be built in the near future. As far as we have been able to learn, every one of these vessels is classed outside of the United States, although possibly two or three may have double classification. The Standard Oil Company of New Jersey has three large ships under construction that are included under this foreign classification; so are the two ships for the Standard Oil Company of New York. The Coastwise Transportation Company of Boston is building six ships under foreign classification; Crowell & Thurlow, of Boston, two; the Luckenbach Steamship Company, one; the New York & Porto Rico Steamship Company, one; the Gulf Refining Company, one; the Anglo-Saxon Petroleum Company, two; the American-Hawaiian Steamship Company, three; A. H. Bull & Co., three; the Munson Steamship Company, one; W. R. Grace & Co., one; the Texas Company, two, and there are several other vessels that have foreign instead of domestic classification. So far as we have been able to learn, practically every one of the fifteen or more vessels reported as about to be contracted for is to be classed across the ocean. The companies that contemplate building these ships include the Ward Line, which is reported to be in the market for four ships.

Surely, under such conditions, the time has arrived for shipbuilders, shipowners, naval architects and other people in the United States who are interested in the subject of classing vessels to get together on the basis referred to by the correspondent above quoted.

A Case of Misplaced Confidence

It is only rarely, we believe, that cause for complaint, similar to that made in the following communication, is found:

"British shipping papers have from time to time called attention to cases where gentlemen representing insurance companies as surveyors, and otherwise, have utilized the influence arising from that position to recommend articles in which they were interested, such as paints, oils, ship chandlery and other goods, to the captains and inspectors of vessels which they were surveying on behalf of underwriters.

"Several cases have arisen where surveyors have been put to the alternative of giving up the one or the other of their connections, for if it is true that no man can serve two masters, that saying applies more forcibly to such cases than perhaps to any other. Unfortunately, foreign insurance and classification societies have not always sufficient work to have an exclusive surveyor representing them at any particular port, and are therefore forced to employ representatives who also have other business interests. Such cases, however, lead to many complaints, and are apt to be the cause of 'jobbery' and injury to the interests of the shipowner.

"Underwriters and classification societies who are faced with the necessity of appointing a representative under such conditions, should make a point of inquiring into the business connections which the prospective surveyor may have, and should make an invariable practice of appointing no one whose other interests or connections are apt to interfere with the impartial discharge of his duties. It is, however, for the surveyors themselves who are placed in such positions to draw the line between their different interests and to fill their positions with the discrimination and uprightness to which their employers are entitled at their hands."

Our correspondent is probably fully justified in calling attention to the state of affairs implied by his communi-

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cation, but we doubt if the average man qualified to exercise the offices of representative or surveyor of a foreign insurance company or classification society would stoop to the betrayal of the confidence imposed upon him by his employers in influencing his clients in the purchase of supplies. If such is the case, both the employer and the surveyor are to blame, and the results are bound to be disastrous to both. The sooner such conditions are eliminated the better for all concerned.

The American Society of Marine Draftsmen

Organized to promote the general welfare of marine draftsmen professionally, intellectually and socially, and to cultivate the highest standard of professional ethics among them, the American Society of Marine Draftsmen is fast winning an enviable place among the professional societies in the United States. Its membership is divided into branches, each branch consisting of the draftsmen either from a single shipyard, or, where several yards are located in the same or nearby cities, from a group of shipyards. The general management of the society is vested in an annual convention, consisting of delegates from the branches, and an executive committee consisting of the national officers, and one committeeman elected each year. The present membership numbers several hundred and is divided into twelve branches composed of draftsmen from practically every shipyard on the Atlantic coast and also one yard on the Pacific coast. Additional branches are now being organized, and in the near future practically every shipbuilding district will be fully represented in this organization.

The object of the society was well outlined in an address made by J. Emile Schmeltzer, president of the society, at the annual banquet recently held in New York. On this point he stated: "The object of the society is to unite the marine draftsmen and to promote their welfare socially, intellectually and professionally. That word 'unite' means friendship, union, mutuality, a binding together—co-operation. It implies action, a concurrent striving together for the attaining of certain objects. Of this co-operation is born fellowship. This organization lifts this fellowship from a mere casual acquaintance to an intimacy and a brotherhood that make for courage, sanity and success. It also lifts its members to a higher plane of professional proficiency. The various shipbuilding companies realize this, and it is now customary for them, when in need of men, to write to the society, asking us to furnish them men of certain stated qualifications."

As to the success of the society, Mr. Schmeltzer stated that it has created harmony and good feeling where petty jealousies and prejudice formerly existed, with the consequent increase in efficiency which is the inevitable result of harmonious feeling among its individual members. It was his sincere belief that the society had not only broadened its members' horizon along intellectual lines by association and by the reading of technical papers before its various branches, but that in the near future it would bring to the marine draftsmen that recognition which is justly their due.

While opinions may differ as to the most desirable qualifications which a marine draftsman should possess, nevertheless it is interesting to note the points which were summarized by Mr. Luther D. Lovekin, chief engineer of the New York Shipbuilding Company, in his remarks on "Marine Draftsmen" given at the society's annual banquet: "The points to which consideration is given by the officers of large shipyards when they are looking for the proper man to fill a vacancy," he said, "are usually: First. Is he an able designer? Second. Has he the necessary engineering or architectural ability? Third. Has he executive ability? Fourth. Is he of steady habits? Fifth. Has he honesty of purpose and a good character?"

With these points in mind the marine draftsman should realize the necessity for the years of hard work at comparatively small financial returns before he can expect promotion to the engineering staff. As Mr. Lovekin pointed out, experience and hard work are prime requisites for success in a profession which requires such a thorough knowledge of the arts and sciences as that of the expert draftsman. That encouragement for the draftsman is not lacking, however, is shown by the closing remarks of Mr. Lovekin's address:

"Shipbuilding at the present time is in a most prosperous condition, and it will not be long before all of the shipyards in the United States will be filled with orders. Further than this, it looks to me as though shipbuilding in this country will have full sway for years to come. In fact, I think it fair to state that we will ultimately rank as the greatest of all shipbuilding countries, for surely no other country possesses the natural advantages that we do in these United States."

Shipbuilding in Navy Yards

In the controversy over shipbuilding in navy yards the views of a naval officer given in this issue are of interest, as they throw some light upon the difficulties experienced in providing steady employment for a large force of skilled workmen in a navy yard. As a solution of this problem, he suggests that the navy yards take up the construction of vessels of a distinctly non-military type, as the work on such vessels could be carried on intermittently. In this way the yard force necessary for handling rush repair work would be kept intact, and during slack periods employment would be provided for the men. While such a plan might prove beneficial in maintaining the organization of the yard, yet it would hardly solve the problem of the excessive cost of ship construction in navy yards which has been the main point of the controversy. On account of military considerations, the question of shipbuilding in navy yards cannot be regarded in the same light as shipbuilding in private yards.

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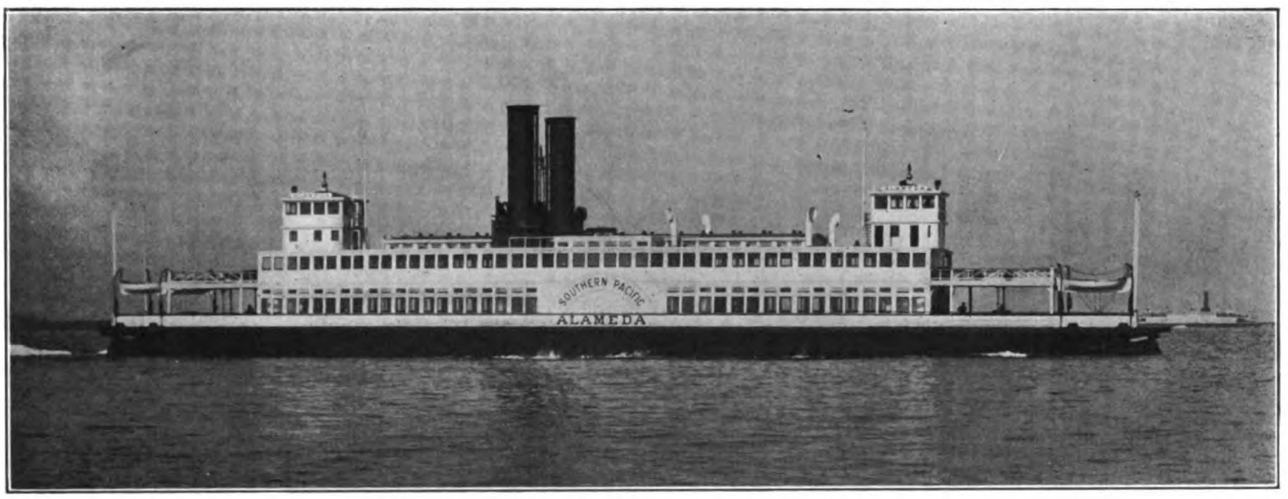


Southern Pacific Ferry Steamer Alameda

Latest Addition to Fleet of Passenger Ferry Steamers Operating Between San Francisco and East Bay Cities

BY EDW. W. OLIN*

It is not generally known that the Southern Pacific Railroad Company has a fleet of passenger ferry steamers operating between San Francisco and the East Bay cities, Oakland, Alameda and Berkeley, which in the point of equipment and service is probably not equaled anywhere in the United States. This fleet consists of ten passenger ferry steamers to which has lately been added the new side-wheel ferry steamer *Alameda* of the following dimensions:

Length over all	293 feet
Length between perpendiculars	273 feet
Beam molded	42 feet
Width over guards	76 feet
Depth molded	17 feet
Displacement, light	1,550 tons
Draft, light	8 feet 3 inches

Besides being the largest and fastest ferry steamer on San Francisco Bay, every effort was put forth to make her the safest, in line with the company's medal-winning policy of "Safety First." She was designed and built under the personal supervision of Mr. Wm. McKenzie, superintendent of ferry and river steamers of the Southern Pacific Company, at a cost exceeding $400,000 (£82,000).

This is the first of a program of three vessels of the same type, with the view of reducing the time between San Francisco and Oakland to 15 minutes, to accommodate the rapidly increasing ferry traffic over the distance of 3⅝ miles between these cities.

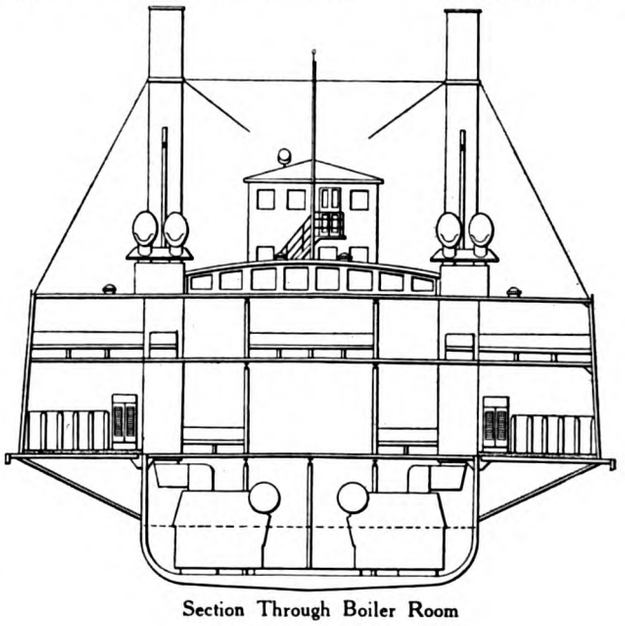
The Southern Pacific ferry service being a part of the great Electric Suburban System, must, in order to to maintain its already efficient service, have a ferry service that will meet each train with clocklike regularity.

Volume of Traffic

The importance of this statement becomes apparent when it is considered that these ferry steamers connect with 749 trains daily and transport about 59,000 passengers each day. During rush hours these steamers handle about 3,500 passengers per trip, and to facilitate the loading and unloading of this human cargo their design and construction must be such that the 3,500 passengers can disembark in less than three minutes.

To meet this latter requirement a 16-foot gangway extends down the centerline of the boat the full lengh of the main deck, to allow free movement without excessive crowding of passengers. In the cabin on the saloon deck two 8-foot gangways extend throughout the cabin, while the saloon deck extends beyond the houseline about 30 feet and is provided with a 24-foot side landing on each side the same as on the main deck. In this manner passengers are unloaded from the main and saloon decks very rapidly.

Allowing 21 inches to a seat, the steamer *Alameda* will seat a total of 1,680 passengers, divided as follows: Main deck 628, saloon deck inside 636, saloon deck outside 316. To meet the public demand for more seats in the open air, seats were left outside the saloon-deck cabin which are



Section Through Boiler Room

* Foreman Draftsman, Southern Pacific Shipyard, West Oakland, Cal.

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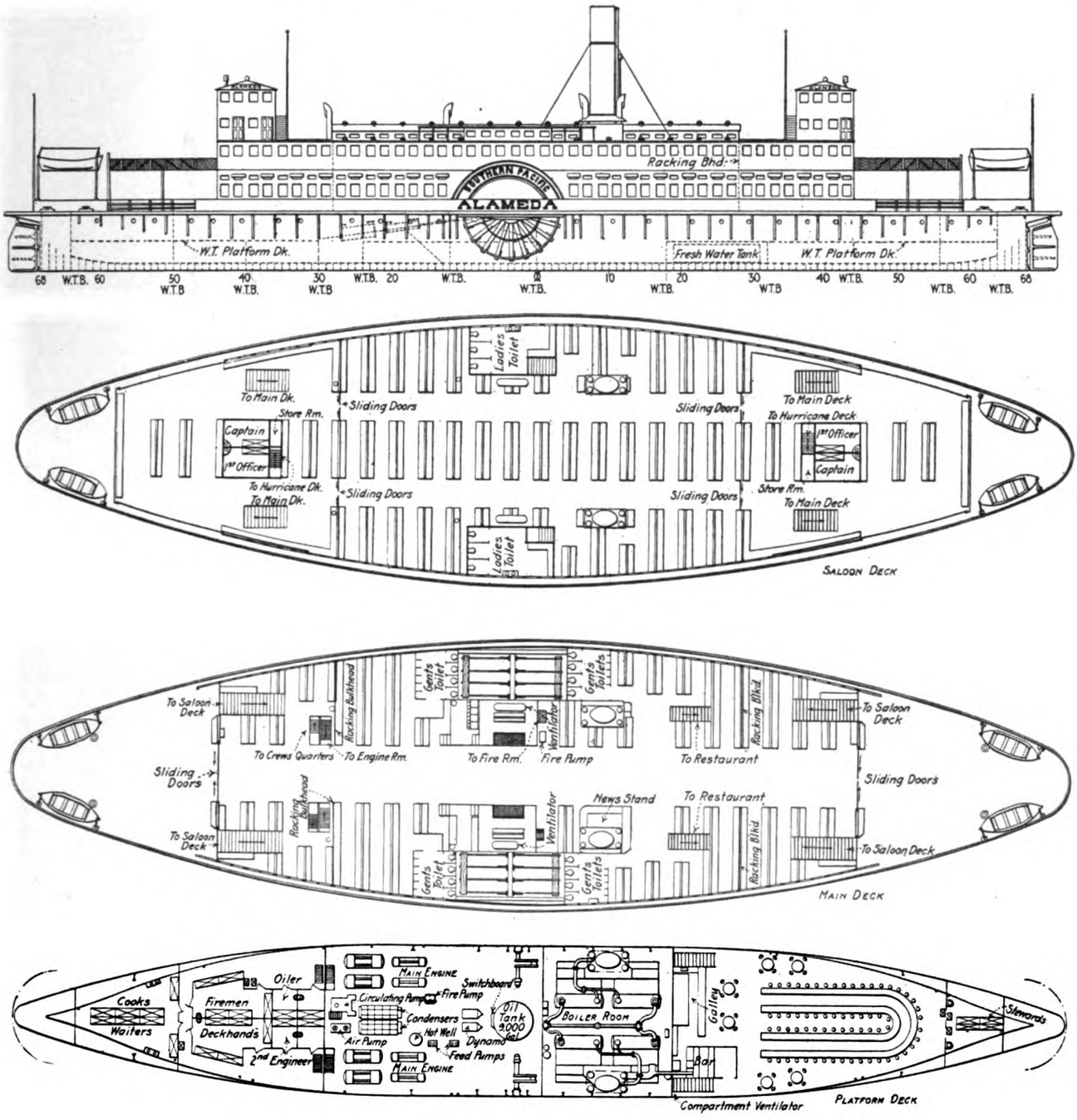

Profile and Deck Plans of the *Alameda*

sheltered only by the sides and the extension of the hurricane deck.

While the time the passengers remain on the boat is only about 20 minutes, great consideration has been given to their comfort. Toilets and lavatories for gentlemen are provided on each side of the paddle box on the main deck. There is also a news stand and a bootblack stand as well as sanitary drinking fountains. Over each paddle box on each side of the saloon deck is located the ladies' toilet, waiting room and lavatory with a matron in attendance. Sanitary drinking fountains are also provided on this deck.

Special attention has been given to the restaurant, which is quite an elaborate affair for this serviec, seating about 76 people. It occupies a space 75 feet forward of the boiler room on the platform deck and has double horseshoe counters as well as private tables. The restaurant presents a very neat and pleasing appearance. The galley is located in the after-end of the restaurant and is open for the inspection of the public, as it is not screened in any way. A No. 2 Audiffren Sinquine refrigerating machine is also installed. The bar room and buffet is located in the restaurant and occupies a space 9 feet by 12 feet, which is built in, forming a separate room.

HULL CONSTRUCTION

The hull is a knockdown steel structure, built by the New York Shipbuilding Co., of Camden, N. J., and re-erected and riveted up at the Southern Pacific Company's shipyard, West Oakland, Cal. In connection with this it may be of interest to know that no difficulty was encountered in the erection and assembling of this hull.

A watertight platform deck 8 feet above the base line extends throughout the length of the ship except in way

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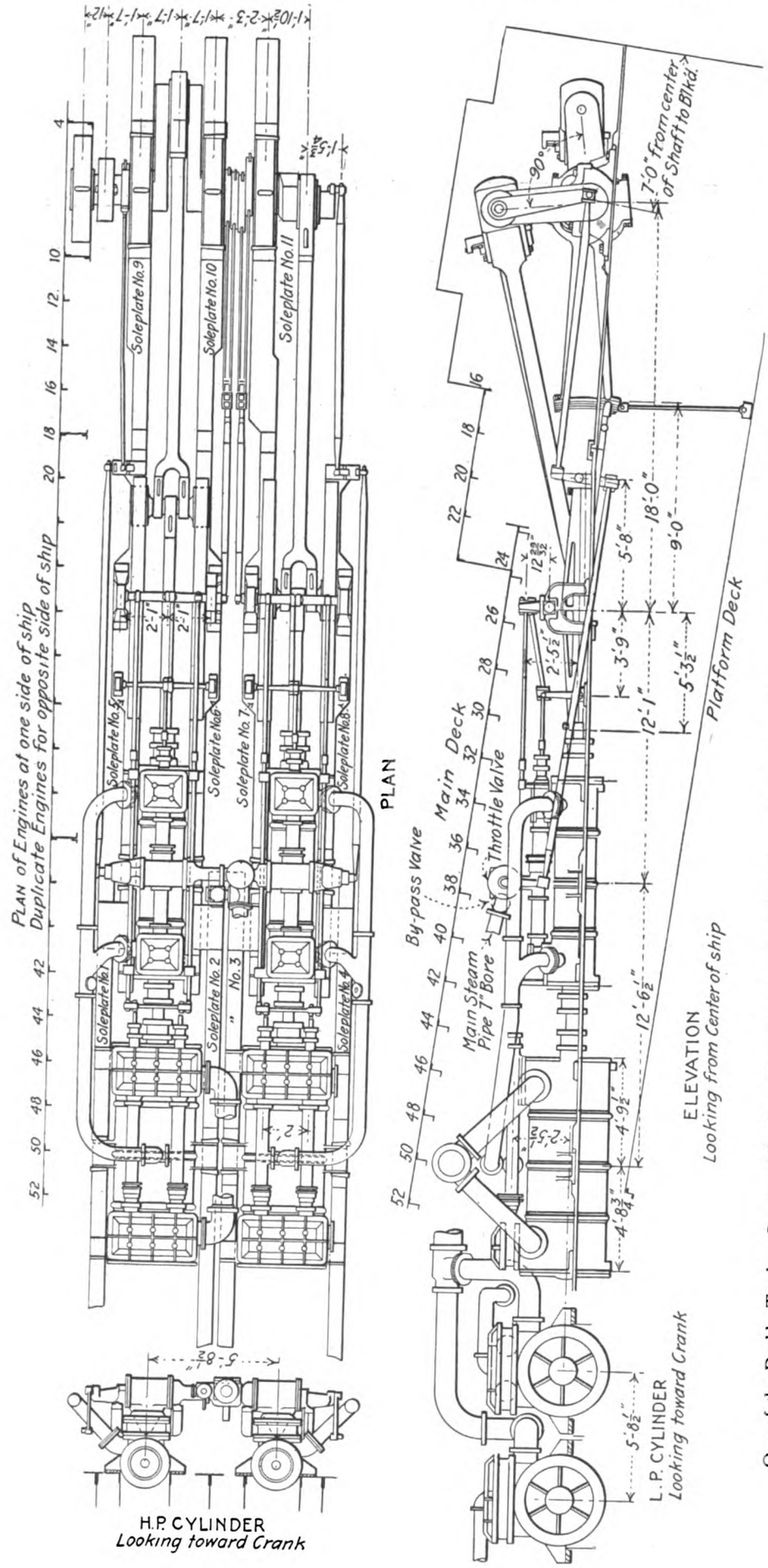

One of the Double Tandem Compound Inclined Condensing Engines Which Drive the Side Wheels of the *Alameda*; Diameter of Cylinders, 20 and 40 Inches; Stroke, 6 Feet; Normal Revolutions per Minute, 25; Indicated Horsepower, 2,500

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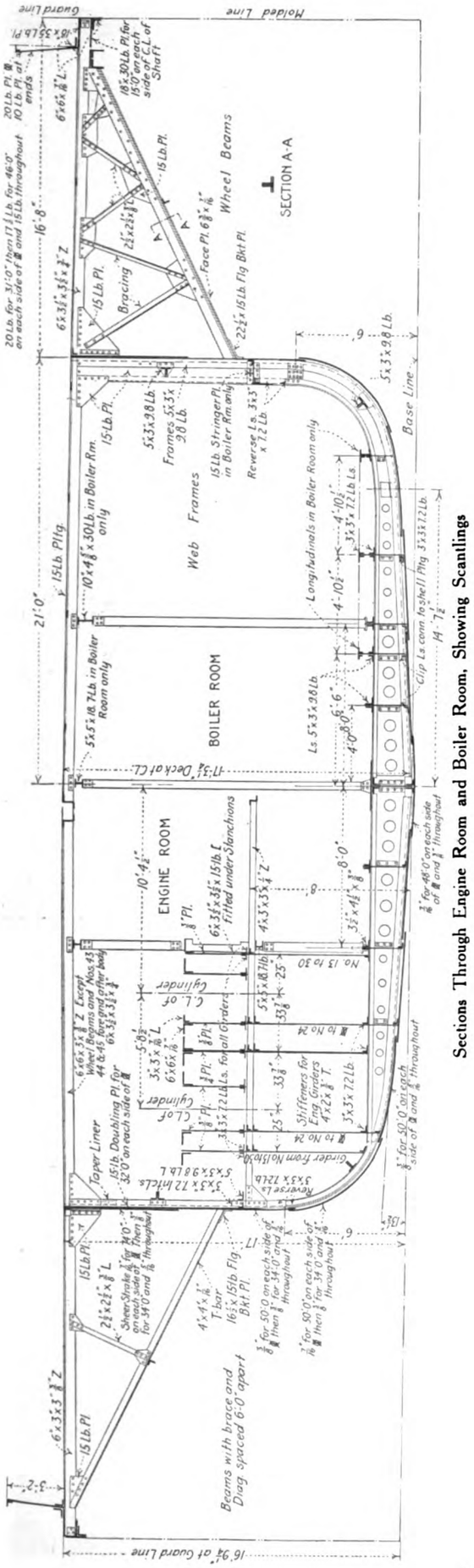

Sections Through Engine Room and Boiler Room, Showing Scantlings

of the boiler room. Immediately abaft the boiler room 60 feet of this deck is taken up by the main engines, while the restaurant occupies the space forward of the boiler room, as before mentioned. The crew accommodations occupy the rest of this deck up to the collision bulkhead.

Twelve watertight transverse bulkheads, seven of which extend to the main deck and five to the platform deck, tend to make this steamer the safest on San Francisco Bay, as any two compartments may be flooded without sinking the boat. That this feature is of prime importance becomes apparent when it is considered that there are eight ferry routes radiating from the Union Depot, San Francisco Market street ferry, from which 18 ferries depart every hour, besides the regular merchant ships crossing the ferry routes. This makes the captain's berth anything but a pleasant one, especially during our heavy winter fogs.

The power plant consists of four Babcock & Wilcox marine boilers with a total heating surface of 10,400 square feet. The boilers are set two on each side of the centerline of the boat, the fireroom being fore and aft with a separate stack for each pair of boilers. Steam is generated at 200 pounds pressure by a steam-atomizing oil-burning system, using the Geo. E. Witt oil burner. Each boiler is equipped with one No. 12 monitor injector for auxiliary feed, the main feed being supplied by two 10-inch by 7-inch by 10-inch Knowles vertical duplex pumps, each with a capacity to supply all boilers. These boiler feed pumps are made automatic in their action by regulating the steam by a butterfly valve, which is controlled by a float in the hotwell.

PROPELLING MACHINERY

The main engines, which were built at the Southern Pacific Company's shops at Sacramento, Cal., consist of a double tandem compound inclined condensing engine on each side of the ship operating independent shafts with cranks set at 90 degrees. The engines are 20 inches by 40 inches diameter with a common stroke of 8 feet and will develop about 2,500 indicated horsepower at 25 revolutions per minute. Both the high- and low-pressure cylinders are equipped with open-box slide valves with Richardson balance strips. The high-pressure cylinder has in addition an auxiliary rotary cutoff located between the steam chests. Between the two cutoff valves is located the main throttle valve, which has a bypass connecting to the low-pressure cylinders for emergency use. The main valves are operated by the Stephenson link motion with stationary links.

It is usual with paddle-wheel steamers of this type to continue the shaft through from side to side, being connected to the inboard engine cranks by an intermediate shaft and drag cranks, but as mentioned before, each wheel is operated independently, which greatly facilitates the control of the ship, as by backing on one wheel and going ahead on the other the ship can be made to turn in her own length.

As the depth of water for about three-fourths mile out from Alameda and Oakland Moles is only 9 feet at low tide, it was impossible to consider a screw propeller of suitable proportions for a ferry steamer of the *Alameda's* dimensions. As the boat is double-ended and runs in one direction as much as the other, a radial paddle was decided upon as being the most suitable for the bay ferry service. The wheel shaft is 16 inches in diameter, of cast vanadium steel, and has four cast-steel wheel flanges or centers to each wheel shaft. Radiating from this wheel flange are 20 bucket arms of 3¾ inches by 12 inches Oregon pine. The buckets are also of Oregon pine 3¾ inches by 18 inches wide by 12 feet 3 inches long.

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The wheel is 24 feet 6 inches diameter over buckets and has a 3-foot dip when light-loaded.

Each pilot house is equipped with two Hutchison rotation indicators which are connected to the port and starboard engine shafts to indicate the direction the wheels are rotating and which act as a means for checking bells between the pilot house and engine room.

AUXILIARIES

A very complete equipment of auxiliary machinery is installed, part of which has already been mentioned. The condensing equipment consists of two Worthington surface condensers of 2,400 square feet of cooling surface each, with valves in the exhaust and circulating pipes for running each condenser independent should occasion demand it. The following pumps are supplied:

One 12-inch Blake volute circulating pump driven by a vertical 8-inch by 7-inch Blake open frame engine.

One 12-inch by 28-inch by 18-inch Knowles single-acting twin beam air pump.

Two 10-inch by 7-inch by 10-inch Knowles vertical duplex boiler feed pumps.

Two bilge and fire pumps 12-inch by 8½-inch by 10-inch Knowles vertical duplex pumps.

One of the latter is located in the engine room and one on the main deck. They are connected to the bilges and separate sea cocks and are connected together with suitable suction and distributing manifolds. As the deck fire pump is constantly running to maintain the necessary fire-line pressure a connection is taken from this line for the water closets and other sanitary systems.

One fresh-water pump 5¼ inches by 3½ inches by 5 inches, of the Knowles vertical type, supplies fresh water to the restaurant and drinking fountains, and two oil pumps 4½ by 2¾ inches by 4 inches, of the Knowles vertical duplex type, are supplied, each of which is able to supply the oil at the necessary pressure.

The electric plant consists of two 35 kilowatt General Electric turbine generators, each of which is capable of illuminating the entire ship. Under each pilot house is located a 4-inch by 6-inch C. H. Evans steering engine.

Considering the nature of the service for which the *Alameda* is intended, her design and equipment leave little to be desired. The facilities for the rapid handling of a large number of passengers at the terminals and for their safety and comfort while in transit, should prove a valuable asset to the owners.

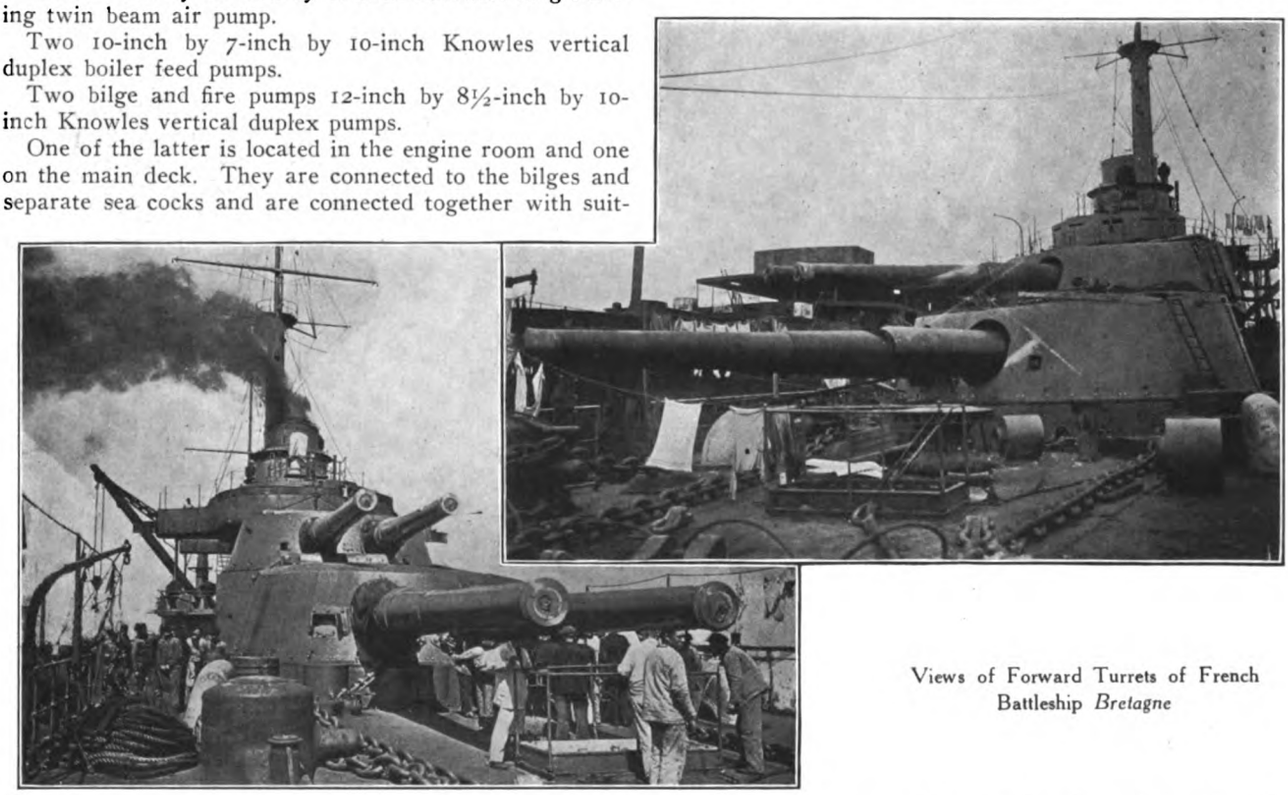
French Battleships Bretagne and Provence

The battleships *Bretagne* and *Provence*, laid down on May 1, 1912, and July 22, 1912, respectively, have recently carried out their official trials and now form a part of the Mediterranean fleet of the French navy, where they are the largest battleships in the fleet. The main particulars of these two battleships are:

Length overall	545	feet
Beam	88	feet
Draft, forward	28	feet
Draft, aft	29	feet 3 inches
Displacement, on normal draft	23,546	tons
Area of midship section	2,752	square feet
Brake horsepower	28,000	
Contract speed	20	knots

In both vessels the hull is similar to that of the *France*, there being, however, no special under-water protection, as was the case in the vessels of the *Gascogne* class, described in the December, 1914, issue of this journal. The main armor belt extends for the full length of the ship, having a maximum thickness of 11 inches for a length of 197 feet amidships, reduced to 7 inches at the ends. This belt of armor extends 5 feet 7 inches above the load waterline and 7 feet 9 inches below the load waterline. Amidships, the funnels, the secondary battery, the base of the conning tower and the base of the central turret are protected by 7-inch armor, forming a citadel. All casemates are also protected by 7-inch armor. There are two protective decks, one of 1 9/16-inch plate, and the other of 3-inch plate, the lower protective deck extending 6 feet below the load waterline.

The single conning tower, which extends well above the forward turrets, is protected by 12-inch armor, the tube leading to the lower decks being protected by 10-inch armor. The conning tower is divided into two compartments. The forward compartment is the navigating



Views of Forward Turrets of French Battleship *Bretagne*

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station and the after compartment the fire-control station. Above the conning tower are two range-finder stations.

On the *Bretagne* steam is supplied at a pressure of 256 pounds per square inch by twenty-four Niclausse boilers of an improved type, having a total heating surface of 65,000 square feet and a total grate area of 2,090 square feet. The funnels on this ship extend to a height of 66 feet above the load waterline. On the *Provence* steam is supplied at the same pressure by eighteen boilers of the Guyot du Temple type, having a total heating surface of 63,000 square feet and a total grate area of 1,500 square feet. This is the first time that boilers of the torpedo boat type have been used on a ship of this size, and the performance of the *Provence* under severe service conditions will be followed with interest—especially so because some of the vessels of the *Normandie* class will also be fitted with this type of boilers.

According to the contract, the following figures for coal consumption were stipulated: 10-hour full power trial, 2,700 pounds per mile; 3-hour full power trial, forced draft, 321 pounds per square foot grate area; air-pressure in boiler rooms, 1 inch of water; 24-hour trial, 1,853 pounds per mile; endurance trial with one-half boilers in service, 1,168 pounds per mile. The bunkers have a capacity of 2,700 tons of coal and 300 tons of oil.

In both vessels the main engines are Parsons turbines, arranged, according to the latest practice, on four shafts, without cruising turbines. The engines for the *Bretagne* were supplied by the Mediterranean Works and for the *Provence* by the Loire Works.

The electric plant consists of four generators, each of 200 kilowatts capacity. Forward and aft, near the turrets, there are also two other similar electric generators, making the total power of the generating sets 1,700 horsepower. All of the generators are driven by high-speed reciprocating engines.

Nearly all of the auxiliaries on the vessels are operated by electricity. Except in the engine and condensing rooms, all parts of the ship are ventilated by electrically-driven fans. The ammunition rooms are cooled by Westinghouse-Leblanc refrigerating apparatus.

The *Bretagne* and *Provence* are the first battleships of the French navy to carry an armament consisting of ten 13.5-inch guns all mounted on the centerline of the vessel. The guns are placed in five turrets located on the centerline of the ship, the guns in turret No. 1, forward, being at an elevation of 30 feet 6 inches above the load waterline; those in turret No. 2 at an elevation of 37 feet 9 inches; those in No. 3, 36 feet 6 inches; in No. 4, 29 feet, and in No. 5, 22 feet. The arc of fire for the guns in turrets Nos. 1 and 2 is 135 degrees; in Nos. 2 and 4, 140 degrees, and No. 3, 120 degrees. The turrets are protected by 13.5-inch armor on the face; 10-inch armor at the rear, while the base is protected by 11-inch armor.

The secondary armament consists of twenty-two 5.5-inch guns arranged in five casemates on each side of the ship. These guns have an arc of fire of 120 degrees and are located 19 feet above the load waterline Four 18-inch torpedo tubes are also provided.

LLOYD'S SHIPBUILDING RETURNS.—Lloyd's Shipbuilding returns, which only take into account vessels of 100 tons and upwards the construction of which has actually begun, show that, excluding warships, there were 471 vessels of 1,587,467 gross tons under construction in the United Kingdom at the close of the quarter ending March 31. The tonnage now under construction in the United Kingdom is about 40,000 tons less than that which was in hand at the end of the last quarter and about 303,000 tons less than the total building twelve months ago.

Launch of the Gulfcoast

The oil-tank steamer *Gulfcoast,* contracted for in September, 1914, by the Gulf Refining Company, of Pittsburgh, Pa., was launched at the yards of the New York Shipbuilding Company, Camden, N. J., on March 27. This is the fourth oil-tank steamer to be built for the Gulf Refining Company by the Camden shipbuilders. Her principal dimensions are: 406 feet 6 inches length overall; 51 feet beam and 30 feet 3 inches depth. The vessel is of the two-deck type with raised poop and quarter deck, while the expansion trunk is carried above the main deck. The capacity of the vessel is 2,285,000 gallons of oil in bulk carried in twenty-two separate oiltight compartments, in addition to which there is also a large cargo hold and smaller compartments fitted with the necessary cargo

Launch of the *Gulfcoast*

booms, winches and handling gear in which barreled oil or general cargo can be transported.

The propelling machinery, located aft, designed to give the vessel an average service speed of 11½ knots, consists of triple-expansion engines with cylinders 27, 45 and 75 inches diameter by 48 inches stroke, developing 2,700 indicated horsepower. Steam is supplied at 190 pounds pressure by three single-ended Scotch boilers, 14 feet 8 inches diameter and 11 feet long. The boilers are fitted to burn either coal or oil, the oil burners being of the mechanical atomizing type. The bunkers for the oil fuel have a capacity of 176,000 gallons and are placed at both ends of the vessel, so that either cargo or fuel may be carried as desired.

In addition to the usual auxiliaries, the *Gulfcoast* is fitted with a 2-ton ice machine, an up-to-date machine shop in the engine room, steam- and hand-steering gear and a powerful automatic towing machine. In all, there are seven cargo pumps, each capable of discharging cargo at the same time through an independent line. The electric plant consists of two 10-kilowatt General Electric marine direct-connected sets for 110 volts driven by vertical engines located at the main deck in the engine space.

The ship's officers and wireless operator are berthed amidships, the other quarters being under the raised quarter deck in the after part of the vessel.

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Speed Control on Dreadnought Pennsylvania

Description of Instruments Installed for Recording Revolutions of Propeller Shafts—Data Recorded Used to Control Speed of Ship

To promote harmony between the engine room and the bridge, and make it possible to get just that speed from the engines which is necessary for definite purposes, a system of instruments is to be used on the *Pennsylvania* which gives direct and immediate information at all times on the important subject of speeds of the several shafts, together with the corresponding speed of the ship and other similar matters. The essential parts of this installation, as fitted in the two engine rooms, are shown

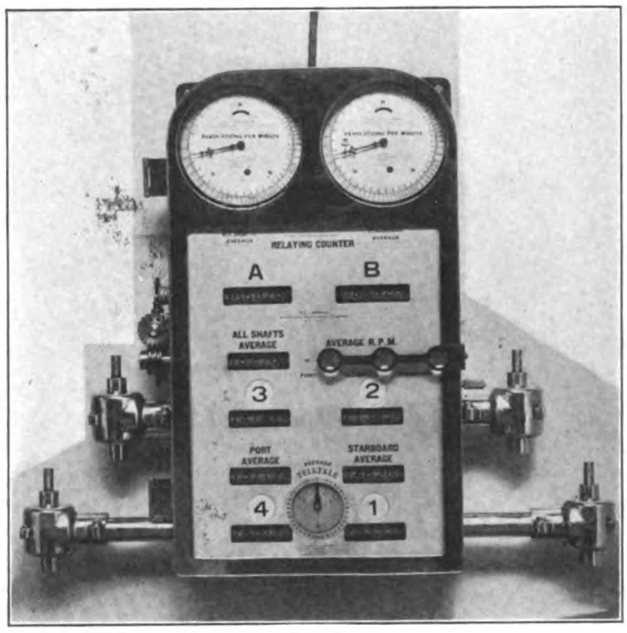

Fig. 1

in Figs. 1 and 2, while Fig. 3 shows the interior of the instrument indicated in Fig. 1. The instruments on the bridge and in the chart house repeat automatically this same information. The apparatus was designed and built by the Cummings Ship Instrument Works, Boston, Mass.

While the instrument shown in Figs. 1 and 3 is complicated in appearance, it is really simply a combination of what in previous ships has been several independent instruments. The nine revolution counters have been in many cases fitted in three or more separate instruments, while the two stop clocks at the top have usually also been separate from the revolution counter equipment, and the telltale is also frequently separate. The instrument as a whole, however, has many interesting features.

The four shafts of the *Pennsylvania* are operated from two engine rooms, two shafts in each. The counters from shafts 1 and 2 in the starboard engine room are run by the gears shown at the right of the instrument, and corresponding with the figures given under those shaft numbers. Similarly, shafts 3 and 4 in the port engine room are arranged on the left of the instrument. The revolutions of the shafts are transmitted to the instrument through the "one-way" gears at right and left respectively, these being arranged so that the counters always *add up*, regardless of the direction of rotation of the engine. The counters, therefore, always tell the total number of revolutions made, whether those were ahead or astern, and thus indicate the amount of work done by the engine.

By a combination of gears the indications of shafts 1 and 2 are averaged in the counter shown between those of the two shafts. It will be noted by a comparison with the figures that the number of revolutions indicated in that average is, in fact, a true average between the figure for No. 1 and that for No. 2. The use of positive-drive gearing for this purpose, as shown in Fig. 3, avoids, it is claimed, the errors inseparable from other methods of driving counters. In a similar way the average of the port shafts is given, and then by a combination of these two averages the average is obtained at once for all shafts, as shown just above No. 3 at the left of the instrument in Fig. 1.

The counters *A* and *B* are used for trial trip purposes and for recording the distance run on any given course. This is important when running on dead reckoning or navigating through a fog, or when for other reasons it becomes necessary to know just how far the ship has been running. It will be noted that the sum of the figures under *A* and *B* is just equal to the total average of all shafts. When *A* is running *B* is stationary, and vice versa. These are controlled from the bridge by an electric circuit so adjusted that only one can run at a time, and it is claimed that the operation is so instantaneously handled that the records are thoroughly reliable in every way.

The telltale at the bottom, showing which engine is running the faster, is controlled by the starboard average counter and port average counter. When the average

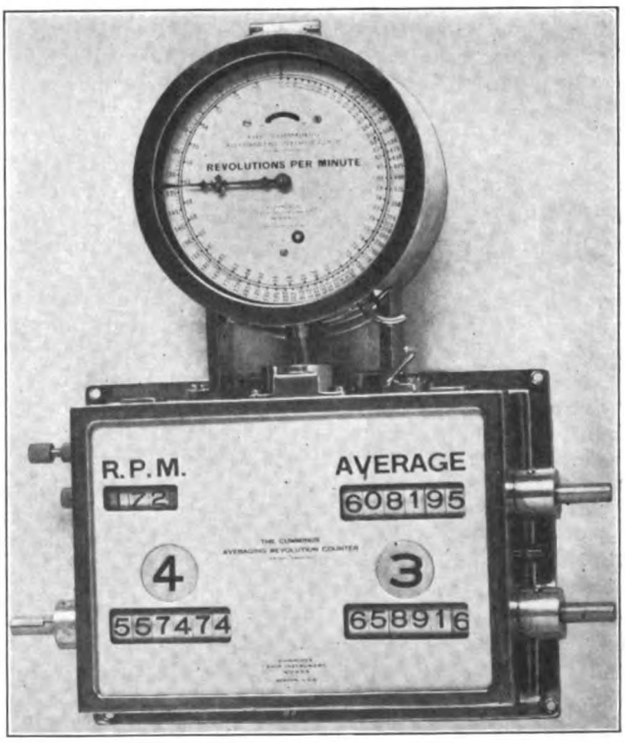

Fig. 2

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revolutions per minute of the starboard engines is the same as that of the port engines the hand does not move. If one side gains, the hand revolves, indicating by its direction of rotation which side is running faster. The dial around the telltale is graduated in revolutions.

The automatic stop clock in the upper right corner is operated mechanically from the starboard average counter. The mechanism is similar to that on the ordinary

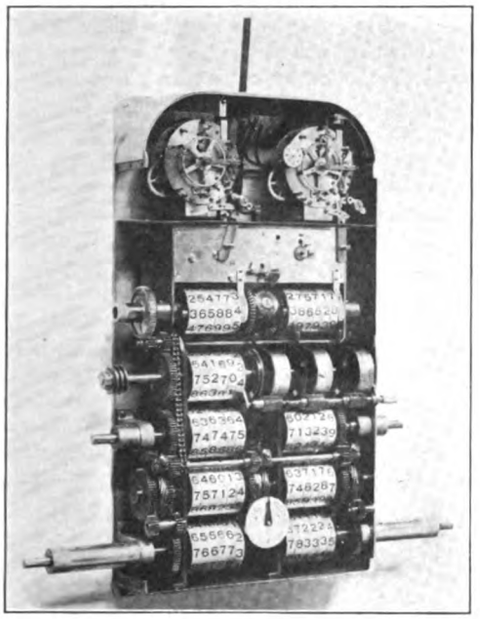

Fig. 3

stop watch, but for continuous use on shipboard a special clock had to be devised which is very much more rugged than any stop watch.

The hand of the clock, started from zero automatically, stops after 100 revolutions of the shaft have been made. It remains stationary, pointing to the revolutions per minute for a period of 75 revolutions, and is then automatically released and returned to zero. This operation is repeated every 200 revolutions.

As the revolutions governing this clock are taken off from the starboard average revolution counter, this indicates the average number of revolutions per minute for shafts 1 and 2. As installed on shipboard, the speed of ship corresponding to revolutions per minute is placed on the outer edge of the dial, and the engineer at once knows just how fast the vessel is moving through the water. If the engines are running faster than 200 revolutions per minute a reading is given oftener than once a minute. The clocks may be thrown out of gear when not in use.

The operation of the instrument shown in Fig. 2, which is located in the port engine room, is identical with that already described. It shows just what the port engines are doing, in the same way that the starboard instrument shows what the starboard engines are doing. The starboard instrument has the further advantage, however, of showing what *all* the shafts are doing, and of carrying the relaying counter for trial trip and other purposes, as well as the telltale and other details.

The indication of average revolutions per minute by a source independent of the stop clock is sometimes found important. This is given at the upper left corner of the rectangular case in Fig. 2, the knurled knob at the left of the case being pressed in to connect up the gears. The same indications are given on the right side of the large instrument shown in Fig. 1, not only for the starboard average shafts, but for the port average and all shafts. As the cylinders from which these readings are taken are made very compact, and consequently with small figures, magnifying lenses have been introduced to make readings easy.

It should be understood that on the bridge and in other navigating stations similar stop clocks are placed, operated by vacuum and controlled by the geared valve shown at the middle of the left side, Fig. 1. Engine logs are also fitted on the bridge for showing the distance covered by the ship. The system has been worked out in such detail that it is quite unnecessary for the navigating officer to telehpone to the engine room, or communicate in any other way, to learn what the engines are doing. The information is all before him in the automatic instruments; he can see at a glance just what the conditions are, and can take what steps may be necessary to produce the result he desires.

Equipment similar to the *Pennsylvania's* has been fitted on practically every dreadnought in the United States navy, and on many of the earlier ships. It happens, however, that in the other cases the system has not been carried out to quite the same degree of thoroughness, although the major items of the information are transmitted automatically to the bridge in all cases.

Latest Developments in Marine Electrical Engineering*

BY H. A. HORNOR †

Although it is to be expected that electrical marine applications should be rapid, the developments in this branch of engineering in the last five years are remarkable. Minor applications which were in the experimental stage three years ago are now regular requirements for the more severe and larger service. Such equipments as electric bilge pumps, electric steering gear, etc., though they were utilized on certain foreign ships-of-the-line years ago, held no place in our practice until recently. It is a long span from Jacobi's electrically propelled boat of 1838 to the U. S. fleet collier *Jupiter* of 1913, but the gap of years contains progress in the art that will stabilize the application.

General Installation

Following the usage of the time, 80 volts direct current was first adopted. The battleships *Kearsarge* and *Kentucky*, building in 1899, were equipped with a three-wire system using 80 and 160 volts. This precedent led to the standard voltage of 125 volts adopted in 1902. Last year the voltage was raised to 230 volts direct current.

This increase of potential, caused by the expansion of power applications, is disadvantageous to the lighting system and searchlights. The development of the 230-volt tungsten lamp in this country is not such as to insure its adoption at the present time, and searchlight lamps require an arc voltage of 50 to 55. These conditions have brought about the consideration of a system employing either three-wire generators or two-wire generators and balancers. Thus there is provided 230 volts for the power system and 120 volts for lighting and searchlights. A standard three-wire generator has not been adopted, and the proposition, therefore, must be classified experimental.

Early in 1913 the standard conduit installation which had for some years been undergoing modifications and

* Paper presented before Section D, American Association for the Advancement of Science, Philadelphia, Pa., December, 1914.

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experimentations gave place to lead-covered steel-armored conductors. This required new designs and methods for its proper installation, entailing changes in all the appliances, fittings and fixtures throughout the equipment. It has led to a great reduction in grounds, it reduces the space and weight required for installation, it allows for further expansion, and incidentally presents a less obtrusive appearance.

Much improvement has been sought in the use of special insulating compositions to supersede porcelain. Various types of asbestos lumber, ebony asbestos wood, and like patented preparations are now generally required. Control panels, interior fittings, etc., are constructed of such materials and at the present time seem to give satisfaction. These experiments have led to the requirement of some such material for the main switchboards, superseding slate for this purpose. As this is a recent requirement, no switchboards of large size have been manufactured and the questions involved rest in the hands of the designer.

As the tungsten lamp has improved in land practice, it now becomes acceptable in marine work. As stated above, the voltage (120) is still maintained the same because of the tungsten lamp. Vibrations in certain parts of the vessel, naturally in the vicinity of the engine spaces, is severe, and carbon lamps cannot be entirely eliminated. The introduction of the tungsten lamps has awakened a renewed interest in the principles of good illumination, and experiments are now under way with prismatic globes, special reflectors, etc.

Many of the above points, and perhaps all combined, have brought improved methods of light distribution, and the manner of controlling light. This in turn has caused more economical methods of running feeders to centers of distribution, and so produced an installation that is far superior to the old methods in cost of upkeep and reliability of service. Incidentally, it has tended to simplicity which materially affects the cost both first and last and points to a hoped-for standard.

SEARCHLIGHTS

The old automatic magnet control of the arc has now been replaced by the motor-operated lamp. Experiments with different compositions of carbon so as to produce greater intrinsic brightness at the source is in progress at the present time. The foreign manufacturer is employing an impregnated carbon which permits a higher potential at the arc—70 to 75 volts instead of 50 to 55 volts. A lamp using the alcohol spray is under consideration. This lamp is of interest, due to the increased illumination. A small positive carbon is used and high temperature of the arc is effected by the use of the alcohol spray. It is understood that impregnated carbons are also employed. It is not known whether any attempts have been made to utilize high power gas-filled tungsten lamps for this purpose, but it is supposed that such a field would be promising. The pendulum swings between the advantages of electrically controlled searchlights and hand or mechanically controlled lights, but at this time the electrically controlled light is not in favor.

POWER SYSTEM

The steady improvement and continued use of contactors for the control of motors has increased the use of automatic control for a varied number of applications. Dynamic braking, which quickly brings the motor armature to rest, is asserting its certain importance in many equipments.

Electricity is now solely depended upon for weighing the anchor, and, although the results of this application for all conditions of service are not known, it is reasonable to believe that the application will warrant its continuance.

Experimental work for the last five or six years has brought electrical steering gear into what appears to be a permanent requirement. The older systems tried did not give satisfactory results and it was not until the development of the contactor that experimental work was again resumed. There are now two systems designed which will be shortly tried in service. One is based on the use of two motors controlled by contactors; the other based on one motor controlled by a motor generator on the Ward-Leonard system. Any type of electrical system is to-day paralleled by the old steam system, but the indications are that the electric gear will supplant the steam.

The introduction of oil fuel instead of coal has changed the electric forced draft fan to a steam turbine driven fan, due in part to the fact that high-pressure and low volume of air is required, and also to the fact that the exhaust from these fans aids the heating of the boiler feed water.

The main drainage pumps are electrically driven, but the application to other main engine auxiliaries has not increased generally. There is a movement toward rotary steam pumps instead of the old reciprocating pumps which doubtless will lead in the end to the electric motor.

INTERIOR COMMUNICATION

The old types of incandescent lamp instruments have almost entirely disappeared and their place taken by the direct current motor-operated instrument. The communicating systems as a whole have increased greatly in extent. No absolute measure of this expansion can be given, but it is about 60 percent.

One of the most important and interesting developments is that of the gyroscopic compass. Since 1852, when Foucault in his laboratory studied the physical action of the gyroscope and laid down its laws, scientists and inventors endeavored to produce for it some commercial usefulness. It is not the purpose of this paper to describe or narrate the history of this application. Those who are interested will do well to read Mr. H. C. Ford's paper, entitled "The Electrically Driven Gyroscope in Marine Work," read before the American Institute of Electrical Engineers at Detroit, June 23, 1914. It answers the intention of these notes to record that recent improvements in the essential point of quickly damping the oscillations has advanced the practical adaptability of this instrument. A demonstration of this improvement was given by Mr. Elmer A. Sperry before the three-hundredth meeting of the American Institute of Electrical Engineers, held in Philadelphia last October.

WIRELESS TELEGRAPH

The improvements in wireless telegraph apparatus have been rapid and important. Most of these advances have been recorded elsewhere and need no further comment. In general the lines of improvement tend to the use of a continuous wave in preference to the undamped wave. Much success has been achieved by the quench-spark system. Matters of practical installation are more carefully looked after, and the value of wireless as a safety factor has not been exaggerated by the press.

SUBMARINE SIGNALING

Perhaps the most important advance in the protection of vessels occurred in the early part of this year. For many years and by many minds the transmission of sound signals through water was given special consider-

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ation. Water as a medium of signaling has many more desirable characteristics than air. The submarine bell attached to the buoy, the lightship or the shore could emit signals such that a vessel equipped with water tank and receiver telephones could evade those places in which there was danger, and so be protected in foggy or thick weather. But there remained no under water means by which a vessel could itself communicate either with the shore or with another vessel. The submarine telegraph oscillator is the work of Prof. R. A. Fessenden, and provides for under water inter-communication by the telegraph or telephone.

So much interest surrounds this apparatus that it seems desirable to quote from an abstract of Mr. R. F. Blake's paper, read before the American Institute of Electrical Engineers at Philadelphia, October 12, 1914: "The apparatus consists of an oscillating electric motor generator which has a strong electro-magnet surrounding a central core on which is an alternating current winding. This copper tube is attached to a large diaphragm. When the alternating current passes through the core winding it induces a current in the copper tube, which, being free to move, vibrates back and forth, thus setting the diaphragm in vibration. . . . This oscillator can also be used as a receiver." From this brief description it can be seen that a most important field is now covered by this apparatus.

ELECTRIC PROPULSION

Since Davenport, the Vermont blacksmith, exhibited his electric motor in London many attempts have been made to apply electricity to the propulsion of vessels. Many will recall the electric launches at the Chicago World's Fair in 1893. Abroad some light draft river craft were built and so squipped. A few years ago two electrically driven fire boats for the city of Chicago were successfully operated. A vessel built in England to ply in the Welland Canal was equipped with electric motors and Diesel oil engine generators. However, the first practical application to a sea-going vessel is the U. S. fleet collier *Jupiter*.

The keel of the *Jupiter* was laid at the Navy Yard, Mare Island, California, on October 18, 1911. The *Jupiter* was placed in commission April 7, 1913. The vessel was designed for a speed of 14 knots, developing 5,500 shaft horsepower with a load displacement of 19,300 tons at a draft of 27 feet 8½ inches. Her performance showed a speed of 14.99 knots, developing 7,151.9 shaft horsepower with a displacement of 19,452 tons at a draft of 27 feet 7½ inches. She has been in service over a year and a half, during which time she has had two trial trips, performed the regular functions of a collier, steamed 14,000 miles, and successfully arrived at the Philadelphia Navy Yard on a continuous trip from San Francisco, stopping only in the Panama Canal in order to view the operation of this great engineering project. During this service only two repairs have been made to the propelling apparatus. One of these could have happened to any type of engine; the other was of such minor importance that it need not be mentioned.

The success of the *Jupiter* is manyfold. The fuel economy is shown to be 25 percent better than the best of like vessels equipped with other methods of propulsion. The propellers are exceedingly efficient, giving the same speed as sister ships with a reduction of 300 to 800 horsepower. The maneuvering qualities of the vessel are markedly superior, due to the rapidity of reversal and also to the fact that full power is available for backing. The ship is about 542 feet long and about 65 feet in beam, and would be extremely unwieldy if it were not possible to aid the rudder by means of the propelling motors. There are many more advantages, but the all-important matter is well summed up in the conclusion of a paper by Lieut. S. M. Robinson, U. S. N., read before the Society of Naval Architects and Marine Engineers, on December 10, 1914: "After all, the greatest test of the satisfactory working of any machinery is whether or not the men who are actually handling and caring for it are pleased with it. If this test applies to the *Jupiter's* machinery it certainly is an unqualified success. In particular is this true if the matter is referred to the coal passers in the fire room, who have to handle much less coal than do the men on sister ships. The ship can make her contract speed of 14 knots without using forced draft at all."

The success of the *Jupiter* has led the U. S. Government to extend this application, and electric propulsion is now authorized for the battleship *California*, now building in the New York Navy Yard. This equipment naturally will be an advancement over that of the *Jupiter*. With this development many more advantages may be expected, as electricity provides ready means for the accurate measurement and determination of propulsion factors. As the application grows many problems of the naval architect and marine engineer will be reopened, doubtless to the betterment of water transportation. There remains to the shipbuilding art to-day many questions that are settled upon theory because facilities are not given to practically record the conditions of performance. This obstruction will be greatly removed by the application of electricity.

The first announcement of the principles of electric propulsion of naval vessels may be found in a paper read by Mr. W. L. R. Emmet before the Society of Naval Architects and Marine Engineers on November 18, 1909. It is to Mr. Emmet that credit should be given for the introduction of what will doubtless prove to be the best and safest means of ship propulsion, to say nothing of the increased possibilities for the advancement of the art of ship design.

CONCLUSION

The last half decade is replete with progress in the marine applications of electricity. It is noteworthy that these applications have followed land development in the electric field. From an auxiliary of little importance except lighting, electrical applications of power have grown until now we find electricity entering into the main design of the vessel. The marine engineer is willing to admit that an electric motor will drive a ship, but imagine his astonishment when he finds in the future to what extent the full effect of this application will lead!

MONTHLY SHIPBUILDING RETURNS.—The Bureau of Navigation, Department of Commerce, reports 111 sailing, steam and unrigged vessels of 24,538 gross tons built in the United States and officially numbered during the month of March. Seven of these vessels, aggregating 18,567 gross tons, were steel steamships. From other sources than construction, six vessels (officially numbered in accordance with the Act of August 18, 1914) of 15,123 gross tons, were also added to the American merchant marine during the month. The Bureau of Navigation further reports for the nine months ended March 31, 714 vessels of 153,326 gross tons built and officially numbered in the United States. During the corresponding period a year ago, 881 vessels of 215,059 gross tons were built and officially numbered.

SALE OF THE SKINNER SHIPBUILDING COMPANY.—The property of the Skinner Shipbuilding & Dry Dock Company, Baltimore, Md., has been purchased recently at public auction by a committee representing the bondholders of the company.

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Application of Electricity to Propulsion*

Fifty-Foot Motor Boat Equipped with Electric Drive for Experimental Purposes—Problems to Be Solved

BY WILLIAM T. DONNELLY †

Since the advent of electricity and its marvelous development for lighting and power through its distribution from central stations, engineers have repeatedly turned their attention to the possibility of its use for marine purposes. It was early found practical to install an independently driven electric lighting plant on board a steamship, and from time to time additional work has been found for the auxiliary use of electricity on board vessels. Repeated examination, however, has resulted in a many times repeated statement that nothing was to be gained by turning mechanical energy into electricity, and then back into mechanical energy for application to ship propulsion. This conclusion was more or less confirmed from time to time by the building of individual vessels propelled by electricity, and this was the situation when the writer's attention was first concentrated upon the problem as to whether it was possible that engineers generally were overlooking a broad method of the application of electricity to marine transportation.

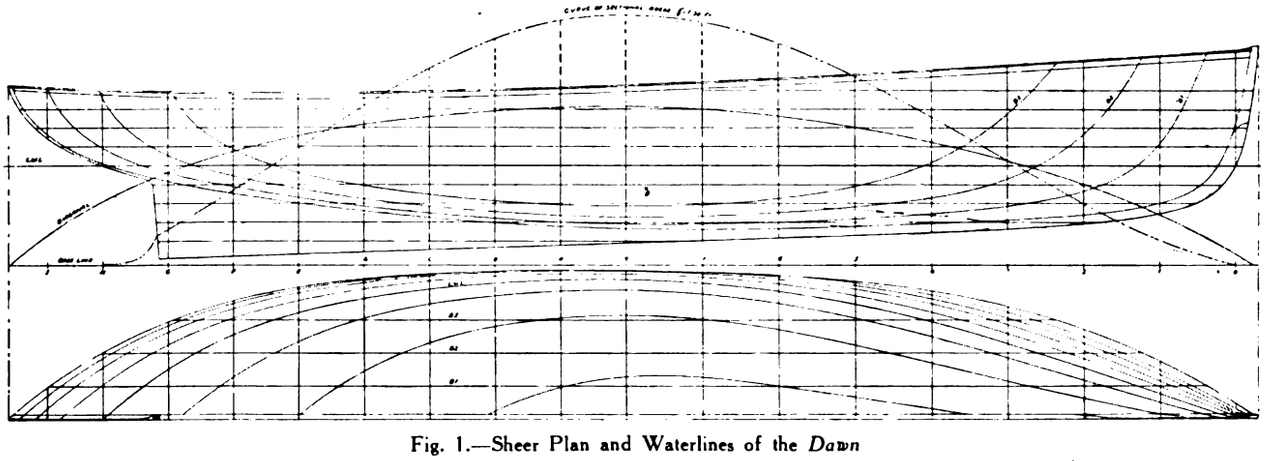

Fig. 1.—Sheer Plan and Waterlines of the *Dawn*

In this case at least a problem was definitely and clearly set before the writer's mind, without any possible solution in sight, and a considerable time was spent in looking at an apparently blank wall. Finally the comparison was made between the movement of cars by means of a multiple electric drive and the towing of vessels by a tug boat, when it first dawned upon the writer that towing was a means of transmitting power, which upon analysis was of the most crude form—that is, a tow boat in towing a vessel transmits power to that vessel, but is limited in character to a force applied in one direction only, and only in a straight line. The rate of transmitting power is, of course, very simple, and is represented by the pull on the tow line expressed in pounds multiplied by the speed of advance in feet per minute of the tow boat and following vessel. To express the transmission in horsepower it is only necessary to divide the product by 33,000 pounds, representing one horsepower.

When so much of the problem had been solved, the rest was very simple. It was very apparent that the use of electricity for power purposes on land was simply the displacing of older and cruder means of power transmission represented by the turning shaft, the running belt or wire rope. Each of these devices was, however, much more developed and less crude in form than that of towing with a tow line.

The invention I am calling attention to is simply due to the full comprehension of the fundamental principles of the application of power to marine propulsion, and then adapting to that purpose electricity by means of apparatus already fully developed. Stated in its simplest form, it is the generation of electricity upon one vessel transmitting it by means of a flexible waterproof cable to one or more other vessels, and there utilizing the energy for propulsion through propelling apparatus operated by the electric motor.

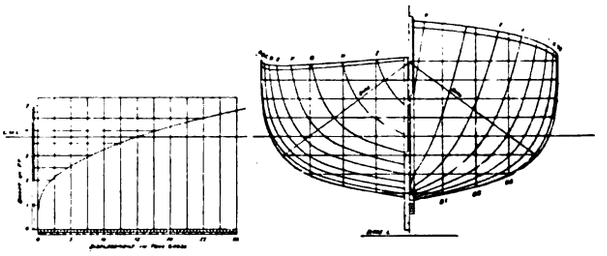

Fig. 2.—Displacement Curve and Body Plan

The writer is fully aware that the possibility, desirability and practicability of doing this may be questioned, and one of the objects of this paper is to put these questions clearly and distinctly before engineers, and at the same time to describe a vessel designed and constructed with the object of testing and determining in an engineering and scientific manner the important questions involved in the problem.

Electrically Propelled Yacht Dawn

The lines of the *Dawn*, Fig. 1, were drawn by Charles D. Mower in 1909; the controlling features in the design were that the boat should be of moderate speed, not more than nine knots, and be of such proportions as to make the functions of hull resistance comparable to commercial vessels. In other words, fineness of lines and refinement of hull were to be a secondary consideration. Consequently the *Dawn* was given a beam of 12 feet on an overall length of 50 feet, with approximately 46 feet length

* Extract from paper read before the Brooklyn Engineers' Club, January 14, 1915.

† Consulting Engineer, 17 Battery Place, New York.

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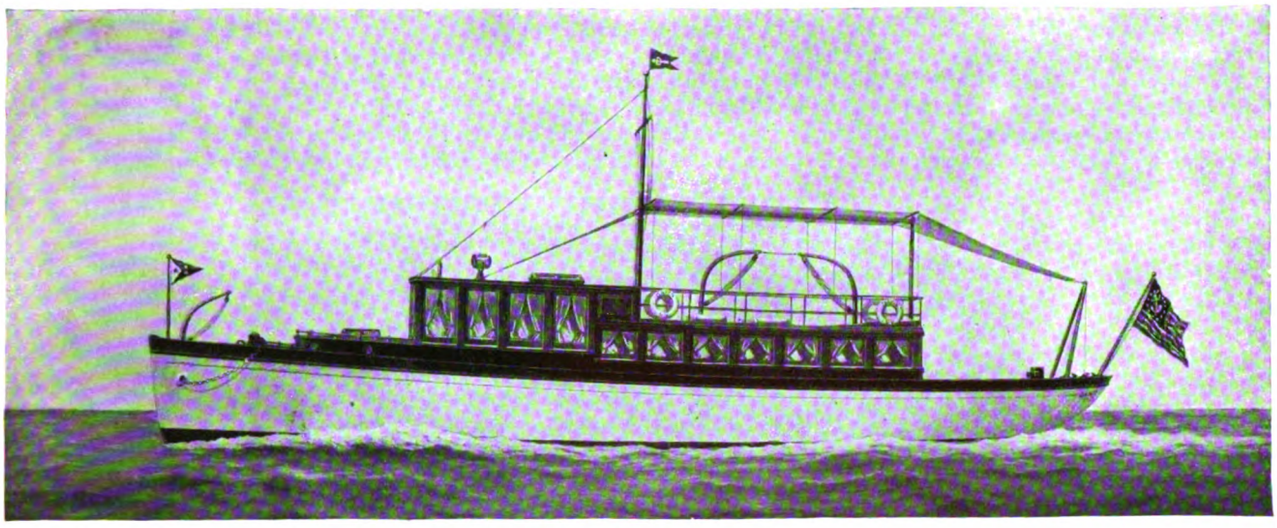

Fig. 3.—Fifty-Foot Motorboat *Dawn*, Equipped with Electric Drive

on waterline and a draft of about 4 feet. The *Dawn* was built by Hehre & Auer, Clason Point, New York. She was launched on August 7, 1914, and put into commission September 9, 1914.

In building, the greatest care was used to conform accurately to the designed lines, and such slight modification as was found necessary was very carefully noted. The lines shown in Fig. 1 are reproductions from the actual hull as built.

The power plant of the *Dawn* consists of a 60 horsepower gasolene (petrol) engine specially built by the Lamb Engine Company. This engine drives a 40-kilowatt generator of 450 revolutions per minute. A 4-kilowatt exciter of 750 revolutions is driven from the main generator through gearing. A 20-horsepower motor, with separately excited fields, designed to run at 450 revolutions per minute, drives the propeller. The excitation of the fields of the main generator and motor from the exciter constitutes the Ward-Leonard system of control, through which, by varying the excitation current in the fields of the generator, it is possible to deliver the full load amperage of the generator to the motor armature at any voltage up to 220, or even considerably higher, by increasing the speed of the generator. By the control of the voltage delivered from the generator as previously referred to, it is possible to run the motor with full load torque at any lower speed desired, it being understood, of course, that the reduction in speed would be in direct proportion to the reduction in voltage.

Fig. 5 shows a photograph of the power plant as it was built and assembled at the plant of the C. & C. Electric Company, Garwood, N. J., who furnished the equipment. The design was such that the entire plant could be assembled and tested in the shop and could be shipped as a unit ready for placing in the boat. The power plant was so located in the boat as to have the main engine and dynamo together with the exciter very readily accessible. The motor for driving the boat is placed forward and below the engine under the pilot house floor, the propeller shaft extending under the engine and generator and connecting through a thrust-bearing and flexible coupling to the propeller shaft.

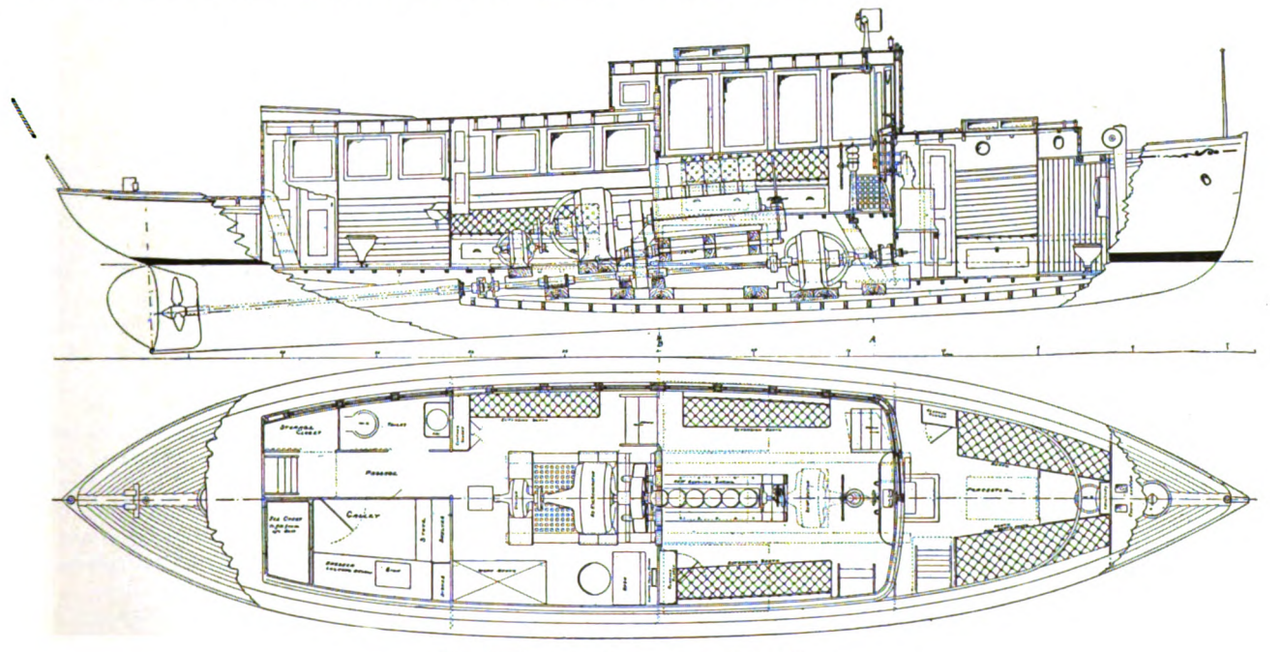

Fig. 4.—General Arrangement of the *Dawn*

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The object for which the *Dawn* was designed was first, for the complete study of all the functions of electric power as applied to marine propulsion—that is, in addition to the power plant, the *Dawn* is supplied with every possible engineering device that can in any way facilitate the accurate determination and measurement of all the functions involved in the application of power to the propulsion of a vessel. At the same time the power plant is able to supply a surplus of from 20 to 30 horsepower for the propulsion of a second boat, and of course all the scientific devices referred to are applicable for determination of the power used in propelling that vessel.

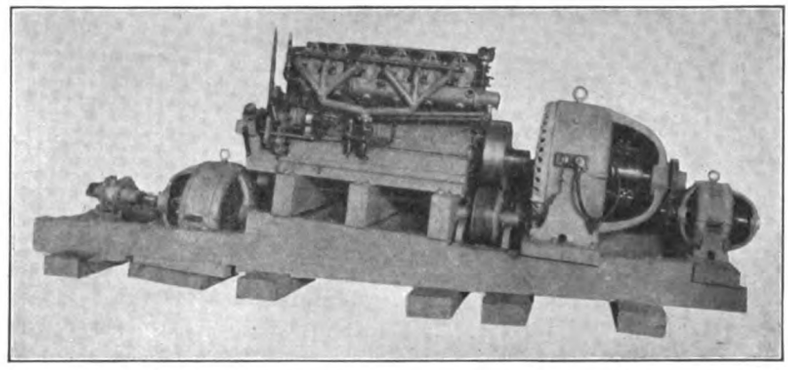

Fig. 5.—Power Plant of the *Dawn*

Details of the Propelling Plant

The 40-kilowatt generator previously referred to operates at a speed of 450 revolutions and 220 volts, and is direct-connected to the gas engine, the bearing next to the engine being omitted. It should be noted that the connection is made by a large flange to the flywheel, thus interposing the mass of the flywheel between the generator and engine to absorb any shock through sudden change of load. The outboard bearing of the generator is carried in a substantial bracket and turns on a ball bearing, reducing the friction to a minimum.

The generator is of the four-pole type, armature wound with copper bars built in slots. Very careful provision has been made both in the armature and generator for ventilation to increase overload capacity. Four interpoles are used to make commutation perfect under all conditions of load and field excitation. The field windings are arranged for separate excitation to provide for the delivery of current at any desired voltage which constitutes the principal feature of the Ward-Leonard system of control.

The 4-kilowatt exciter is driven by gearing from the main generator at a speed of 750 revolutions per minute. This machine is of rugged construction and liberal design, the armature being carried on ball bearings. The machine is of the four-pole type and is provided with a field regulator and compound field windings, so that it can supply a constant voltage for lighting and other purposes besides furnishing current for exciting the fields of the main generator.

As shown in Fig. 5, the 20-horsepower electric motor is directly coupled to the propeller shaft. This is a four-pole motor with separate field excitation, wound for 450 revolutions with 220 volts. Directly ahead of the motor (see Fig. 6) is a cylinder fitted with a piston arranged to revolve freely and to have a slight motion forward and aft. A ball bearing on each side of the piston is designed to take the thrust in either direction. To measure the thrust, oil is to be forced by a small hand pump between the cylinder head and piston, forcing the piston off the bearing, and the pressure of the oil is to read on the gage board to be described later in the article. It will be understood that a separate gage is provided to read the pressure on the piston in each direction.

With the characteristics of the generator and motor known, and with a record of the revolutions and thrust, the propeller efficiency can be readily determined.

Thrust Bearing

Referring to Fig. 7, there will be seen an auxiliary thrust bearing located on the motor shaft between the motor and the propeller. This thrust bearing was designed for use at times other than when experimental work was under way. It consists of a plain bearing lined with a metalline bushing, and on each end of this bearing is also provided a metalline disk. The bearing is 2 7/16 inches in diameter, 11 inches in length, and the disks on each end are 7 inches in diameter. The metalline bearing is a bronze bushing or plate bored with holes 3/8 inch to 1/2 inch in diameter, in which are inserted plugs of graphite. Attached to the shaft on each end of this bearing is a plain cast iron collar held with a key and set screw to prevent the possibility of end movement. No particular care was taken with the construction of this bearing or with the facing of the cast iron flanges. It will be understood that it runs absolutely dry without any provision whatever for lubrication or cooling, and while there was a slight tendency to heat when first put in operation, it was never sufficient to cause a shut down or to interfere with the operation of the boat under full power. During the latter runs the temperature was never greater than could be borne by the hand in contact with it. When it is realized that in this case all the friction must appear in heat and be conducted away by air cooling, it is apparent that the coefficient of resistance must be very low.

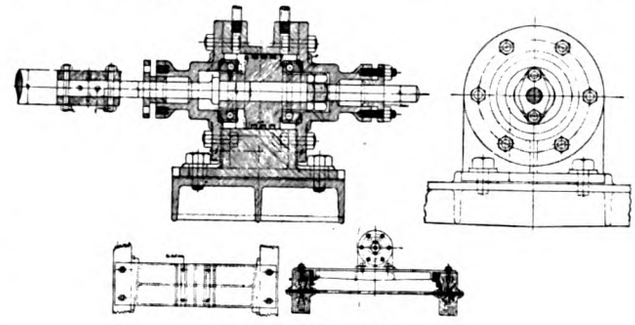

Fig. 6.—Thrust Bearing

It should be stated that metalline bearings are in no sense new, having been used for many purposes for the past twenty-five years; but so far as the writer is aware,

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this is the first case in which an attempt has been made to use the device as a thrust bearing for a boat. While present limited experience is not to be regarded as conclusive, there seems to be very good ground for believing that it is possible to design a thrust bearing which would require neither oil nor attention. From all appearances the wearing qualities of this bearing would be everything that could be desired.

FLEXIBLE COUPLING

As it was necessary to place the motor well forward, the propeller shaft was consequently unusually long, and

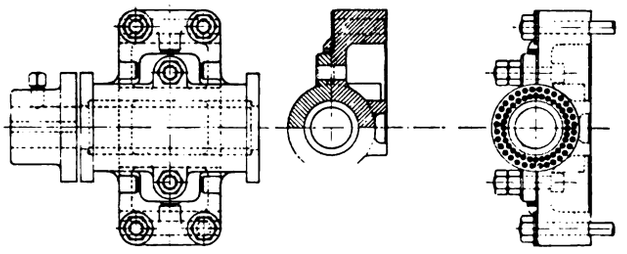

Fig. 7.—Auxiliary Thrust Bearing

it was deemed advisable to insert a flexible coupling to avoid any difficulty from this feature. As it was particularly desired to run the motor when uncoupled from the propeller shaft, it was found necessary to design a special flexible coupling, as shown in Fig. 8. This coupling contains all the functions of a universal joint, but has been greatly simplified by a design which allows for the pins to go entirely through from side to side. The central flange carries two sets of lugs on opposite sides and the flanges attached to the propeller shaft, each carrying a set of lugs. These lugs are bored for 1¼-inch straight pins. These pins are held in place by cotter pins. This device has given excellent results and has proved most satisfactory in operation.

The propeller shaft from the flexible coupling aft is of Tobin bronze and carries a propeller 36 inches in diameter by 26 inches pitch. A great deal of study was given to the proper location of the propeller, and for the finishing of the deadwood. (See Fig. 9.) It will be noticed that the aft bearing of the propeller is carried well out beyond the deadwood, and that a special bronze casting has been made to bring the deadwood down to a fine edge, or, in other words, to carry out the lines of the hull and

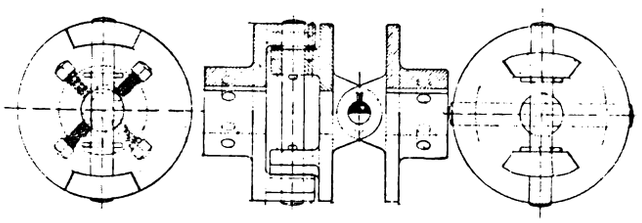

Fig. 8.—Flexible Coupling

deadwood in such a way as not to break up the water flowing to the propeller. There is reason to believe that a very considerable loss in efficiency of the propeller is due to the interference of the water flowing to it. In this construction the refinement referred to is so constructed that it can be removed, and with the facility for accurate measurement afforded by the power plant, an actual determination made as to the increased efficiency due to a careful construction of the deadwood.

The rudder design was carefully worked out along the same lines, and consists of a Tobin bronze rudder stem to which are attached bronze plates riveted around the edge, and as these plates are only 3/32 inch thick, the leading and aft edge of the rudder is only 3/16 inch thick, presenting a fine edge to the water.

INSTRUMENT BOARD

Perhaps the feature of the greatest interest in the equipment of the *Dawn* is the instrument board located at the after end of the pilot house over the engine. This board is about 4 feet square, and by reference to Figs. 10 and 11

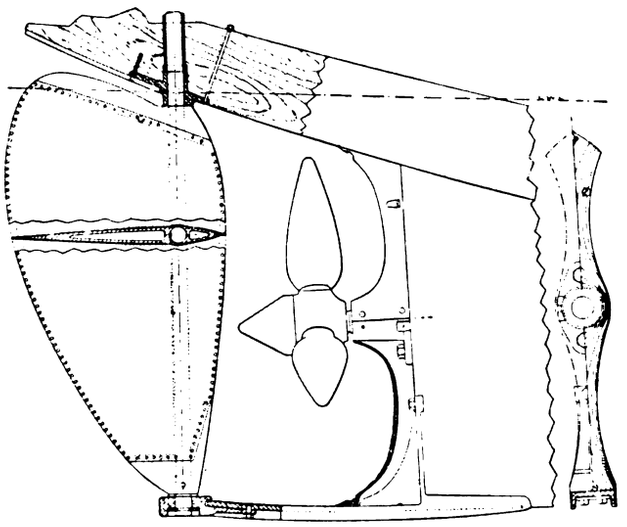

Fig. 9.—Position of Propeller and Rudder

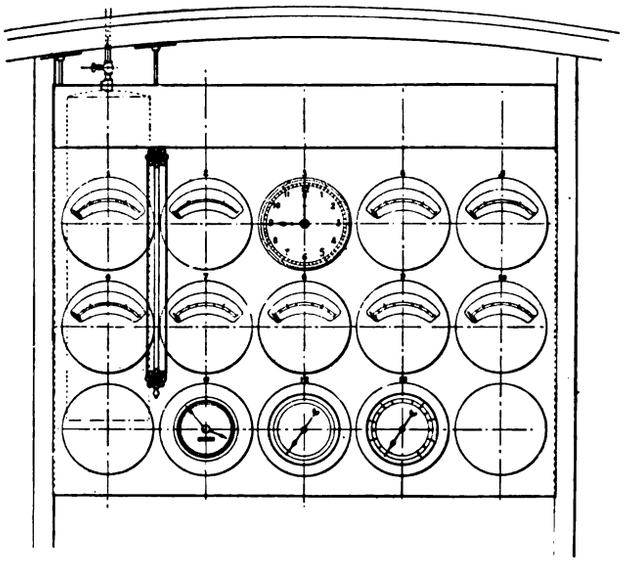

Fig. 10.—Instrument Board

it will be seen that provision has been made for 15 dial instruments; at the present time thirteen are in place. There is also a glass tube connecting direct to a feed tank for gasolene (petrol) on the rear of the board. At the upper edge of the board there is a space for such notation in lettering as will indicate the particular character of the experimental work under way. The instruments shown are: (1) and (2) ammeter and voltmeter for the generator, (3) a clock, (4) and (5) ammeter and volt-

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meter for exciter, (6) and (7) ammeter and voltmeter for motor, (8) electric tachometer, reading revolutions of generator, (9) electric tachometer, reading revolutions of motor, (10) electric tachometer calibrated to read the speed of boat, (11) gasolene (petrol) meter measuring consumption of gasolene (petrol) between main tanks and feed tanks, (12) and (13) pressure gages registering oil pressure of the thrust bearing when going ahead and astern. There is also to be added to this board a U-tube to indicate Pitotemeter pressures as a check on the speed of the boat, and also in investigations of the distribution of water pressures about the hull of the boat when under way. Most of these instruments have been constructed specially for this plant, the electrical instruments by the Keystone Instrument Company, the meter by the National Meter Company, and the steam gages by the American Steam Gauge Company.

To record the reading of these instruments, a bracket is placed on the forward part of the pilot house for a camera and a photograph made of the board at time intervals, as indicated by the clock. (See Fig. 11.) The size and marking of instruments were carefully determined after photographs had been made, and it is to be understood that a 5-inch by 7-inch photograph of the board will give a clear and legible photograph of the reading of all the instruments. So far as the writer is aware, this is the first time that the camera has been utilized to facilitate and record accurate observations under test conditions. To facilitate the photographing, the lighting of the pilot house has been carefully considered, with windows on three sides and a skylight just above the board.

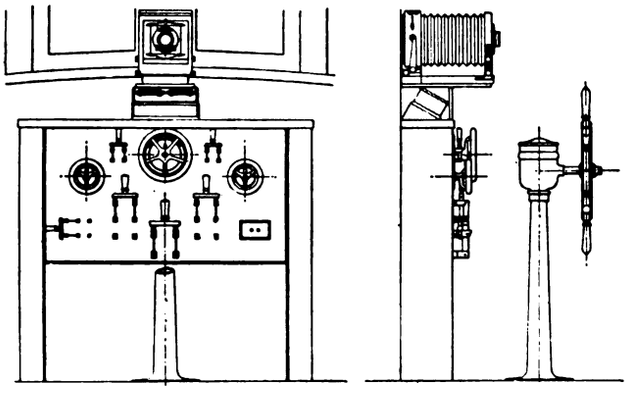

Fig. 11.—Switchboard, Showing Controls

SWITCHBOARD

The wheel for steering the *Dawn* is placed, as usual, in the forward part of the pilot house and directly in front of it is a switchboard giving complete control of the boat while under way. On this board, as shown in Fig. 11, are grouped a main switch for closing the motor circuit, a rheostat in the field circuit of the exciter, a rheostat in the circuit of the exciter, which supplies the fields of the main generator, and a rheostat cutting in resistance in the armature circuit of the motor. It will be understood that the rheostat in the field circuit of the main generator is so constructed that after cutting in resistance to a maximum amount and reducing the voltage to practically zero, a continuation of the rotation in the same direction will reverse the polarity in the fields, and continuation of the motion will cut out resistance. This makes it possible to reduce the speed of the motor and then reverse it by continual motion of this rheostat handle. The rheostat controlling resistance in the armature circuit of the motor is also double, so that when placed on the neutral point the motor circuit is open. Movement in either direction closes the circuit, starts the motor and cuts out resistance. In the practical operation of the *Dawn* I personally use a combination of both systems, —using the Ward-Leonard system to determine the maximum amount of speed to give the propeller and reversing with the ordinary rheostat in the motor circuit. It is, of course, possible to reverse the motor just as quickly as the rheostat handle can be turned, and in no case have I found the motor slow in response.

It will, of course, be understood that with a 40-kilowatt generator, a 20-horsepower motor, it is easily possible to get very much more than 20 horsepower for a short time out of the motor in either direction. This gives a very positive and powerful control of the situation.

One of the most pleasing things about the handling of this boat is to watch the various instruments and to be able to see exactly what is happening and what power is being consumed by the boat.

The *Dawn* was put in commission about September 1, 1914, which gave the writer what time he could afford in the next two months for testing out the machinery, and no time whatever in planning or getting down to real tests. The scientific work for which the *Dawn* is suitable is without limit. Of all the branches of naval architecture, the one relative to the design of screw propellers and their adaptability to ship propulsion is the most obscure and unsatisfactory. The electric propelling plant of the *Dawn*, together with the supplementary instruments and apparatus, is believed to be the most scientific plant ever devised for the practical testing of propellers.

FACILITIES FOR TESTING PROPELLERS

The method which it is proposed to follow is to obtain the drawing of a propeller in use on a line of steamers, and to build from the drawing a propeller of the correct size and pitch suitable for the *Dawn*, and then to test out its efficiency under various conditions of power and speed. A comparison of such tests, together with the best results which can be obtained by modification in the design, should give much positive information.

It is believed that with instruments and apparatus for determining accurately the speed and power applied to the *Dawn* and the hull resistance while under the action of the propeller, will give much more accurate and satisfactory information than is obtainable from tank tests of propeller efficiencies. It is also believed that very much can be learned relative to the influence upon the resistance of hulls in shallow water, in a confined waterway such as a canal, and in the currents of rivers where control and maneuvering power are important considerations.

The practical science of hull design for vessels depends upon the measured resistance of models obtained from towing them in a tank. It is a well-known fact that the propeller materially influences hull resistance. Just how and to what extent is more or less obscure. By designing a model of a large vessel to such a size that it may be driven at approximately the speed of the *Dawn* and supplying the power electrically from the *Dawn*, it will be possible to drive it with its own propeller; in other words, to reproduce in model form the exact conditions of the finished vessel and obtain accurate measurements of all the factors in the problem. By this method it is believed much definite knowledge can be added to the science of naval architecture.

(*To be concluded.*)

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The Operation of a Marine Diesel Engine

Duties of an Engineer in Preparing a Diesel Engine for a Voyage—Starting Up, Maneuvering and General Operation

BY E. N. PERCY

Many marine engineers have made a fairly complete study of the Diesel engine, its principles and the results obtained, but even after the most careful study they find themselves confronted with the lack of knowledge which comes from experience alone. Such knowledge includes the preparation of a marine Diesel engine for a trip, starting it, reversing, general operation and details of maintenance. It is impossible for such information to be obtained by reading, but a sufficient number of points can be touched upon to indicate the precise character of experience necessary before a man can take intelligent charge of a marine Diesel plant.

For a given horsepower a marine Diesel engine compares favorably with a heavy slow speed steam engine of the same power. The maintenance of rods, bearings and thrust is practically the same except that the workmanship is much finer and brasses must be worked much closer.

The pressures are very high in a Diesel engine, running from 400 to 1,200 pounds per square inch according to the type of plant, but in consideration of the fact that for a given horsepower the cylinder is 1/3 to 1/5 the diameter of a steam cylinder, the rods and bearings are about the same size as in a steam engine of the same power, although disproportionate apparently to the size of the cylinder.

Workmanship

A Diesel engine is of much finer workmanship throughout—the bearings are fitted to 128th of an inch or closer. The pistons fit the cylinders very closely and are usually 1/100 inch smaller on top than at the bottom to allow for the expansion due to heat. Six to eight rings are used, having lapped joints, so that there is no possible leakage. Besides this a lubrication ring is used to maintain the film of oil between the main rings and itself.

Diesel engines are either two or four cycle. The valve mechanism in the four cycle engine is the finest mechanism imaginable and the fuel inlet valve, while built very heavily and operating against immense pressures, has a movement of only 1/16 to 1/64 inch and remains open from ⅛ of the stroke down to zero or the merest cut-off, the thickness of a sheet of paper, requiring mechanism of the finest workmanship and most exquisite adjustment.

The oil to these injection valves is pumped usually by a twin plunger, one plunger doing most of the work and discharging the excess oil through an escape valve back into the suction. The second plunger is somewhat smaller and accurately measures the amount of oil forced through the injection valve. On the largest engines these plungers are only about ¼ to ½ inch in diameter, and their stroke varies from one diameter down to nothing.

The oil is atomized by air pressure, varying from 600 to 1,200 pounds per square inch, according to the type of engine. This air is furnished by a three or four stage compressor sometimes attached to the main engine and sometimes to an auxiliary engine and in the more modern boats to both. The air from this same compressor is stored in steel bottles for starting purposes. The average marine Diesel engine carries enough compressed air to turn over for about ten minutes when starting.

The engines are absolutely reliable in starting and reversing provided that preparations have been careful and the inspection thorough. During a stay in port for some days the bearings and pins are overhauled very much as with a steam engine and the valve gear looked after in the same way.

Timing of Valves

The proper timing of the various valves is worked out for each engine by the designers and perfected by the builder during trials. These data are always available on a boat, or if not must be made available, so that when adjustments for changes due to wear or other causes are necessary the gear can be brought to its proper timing without guesswork. Suction valves usually open about five degrees below top center and close on the bottom center. Exhaust valves usually open about ten or twelve degrees below the bottom center and close somewhere near the top center, each on its proper cycle. All valves are closed during compression, expansion and explosion with the exception of the fuel inlet, which has a lead of from five to ten degrees or more according to the speed of the engine, the kind of fuel used and the type of injection valve.

Other factors also enter into this, such as the temperature of the fuel, its viscosity, the pressure of the atomizing air and the type of atomization and apparatus. Engines which have failed on certain kinds of fuel oil have been made successful by raising the pressure of the atomizing air or by pre-heating the fuel or in other ways improving the atomization. If an engine smokes and shows carbon deposit only one of three reasons can exist:

First: The fuel is not being atomized.
Second: The compression is not high enough.
Third: There is an excess of fuel.

If the fuel does not atomize it may be because the viscosity is too high. This can in some cases be remedied by pre-heating the fuel or increasing the amount and pressure of the air used for atomizing, but some of the heavier residual fuel oils are so viscous and have such enormous surface tension that it is absolutely impossible to atomize them into the fine mist necessary for clean combustion under these conditions. If the engine has not sufficient compression the only possible remedy is to use a lighter fuel more easily ignited, because the compression of a Diesel engine is the maximum stress; and as the engine is always designed for this stress it is not possible to increase it substantially without risking the entire structure, and subjecting the bearings to pressures per square inch in excess of those considered in the design.

Sometimes a small advantage can be obtained by speeding up the engine and thus obtaining high temperatures because of the smaller interval of radiation. Again it is possible to increase the compression in certain instances by putting in thicker liners and smaller pistons, thus reducing the bore and making possible an increase of compression. Practically all Diesels have removable liners which make this possible. If the engine is getting too much fuel the remedy is obvious and the method is to change the adjustment of the governor which controls the timing of the inlet valve.

The writer knew of one case where the bell crank connecting the governor to the inlet valve was reversed and the engine was governed and slowed down by the admission of excess fuel and a great deal of experimenting

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was done to account for the abnormal behavior of the engine, the abnormal cards rendered and the great amount of carbon collecting in the cylinders.

INJECTION VALVE

The injection valve necessarily passes through a long stuffing box, which has to withstand the entire pressure of the atomizing air 600 to 1,200 pounds per square inch. The valve is usually raised by cams and returned to its seal by powerful springs. Various devices have been resorted to to minimize friction in the stuffing box, permitting the valve to center on its seat and at the same time preventing it from battering its seat, a rather delicate problem, as the valve is usually only ¼ to ⅝ inch in diameter and the stem two to three feet long. Some firms use an oil lantern in the middle of the stuffing box. Others eliminate the stuffing box entirely, having instead a long stem about 1½ inches in diameter and 18 inches long, fitting closely into a sleeve and having oil grooves instead of packing.

These points have been touched upon at some length because the injection valve with its auxiliaries (pumps) and compressors) is the heart of a Diesel engine. The timing of the injection valve, its control by the governor and the timing of the fuel pumps are the most delicate adjustments on the Diesel engine.

The air inlet and exhaust valves are comparatively easy to set. Cams are usually keyed on to the shaft so they cannot be moved and, if movement is desired, an offset key is made. The only adjustment actually necessary is to compensate for the wear on the valves and this adjustment consists of nothing more or less than lengthening the stem of the valve by means of the sleeve placed there for that purpose until it is the thickness of a sheet of paper from the roller on the lever and the roller on the other end of the lever is taut on the cam, the valve being closed and the cam being down as far as it will go.

The adjustment of the injection valve, pumps, etc., is done with gages furnished by the manufacturers, who are always glad to instruct properly the man in charge. Besides the general work of taking up loose bearings, pins, adjustments, etc., it is customary to clean all valves and their seats and the cages inside and out. The cylinders are carefully cleaned at every opportunity and several times a year the pistons are removed, inspected and cleaned, broken rings replaced and the cylinder thoroughly examined. Marine Diesel engines usually are so designed that the pistons can be easily removed with a minimum effort.

MAINTENANCE

In a general way the maintenance of a Diesel engine is not very different from a steam engine, inasmuch as all the work can be done by any first-class mechanic if properly instructed. One good Diesel man can take charge of a large marine Diesel engine plant in which there is not another Diesel man on board provided they are all good mechanics. In fact the writer knows of two instances where this was done.

When a Diesel engine has been overhauled thoroughly, inspected and adjusted it is ready to start. There are no preliminaries, no steam to get up, no starting of this, that and the other auxiliary, simply open the air valves and the engine starts. In practice aboard ship there is usually a Diesel dynamo engine in operation and a Diesel air compressor. The multi-stage air compressor has usually four stages and stores air at two pressures, one for starting and one for atomization. With the air in storage on a twin screw boat, two compressor engines running and one of the main engines compressing air as soon as it starts there is every chance of getting an engine under way even after several failures.

A new engineer coming into a dead ship that is supposed to be ready to run will first get the dynamos in operation, because practically all auxiliary machinery, such as ice machinery, blowers, hoist, etc., are operated by electricity on a Diesel boat. If the boat does not have even sufficient air stored to start the dynamo engine, a donkey boiler on the upper deck (which is required by law for pumping purposes) is fired up and a small steam compressor operated for several hours.

The next step is to start the auxiliary Diesel compressors. This can be dispensed with, if the main engines are merely being started at the dock, but if maneuvering, the auxiliary compressors should always be in operation, at least until the crew have become thoroughly convinced of the reliability of the main air stored and main engine compressors.

INSPECTION

An inspection of the main engines prior to turning over is somewhat similar to that of a steam engine. The crank pit and thrust are looked at to see that the gear has been cleared away and the turning motor disconnected. The main engine compressors are looked after in the same way and their discharge lines cleared to the reservoir—the pumps are worked by hand until the injection pipes and injection valves are filled as pet cocks on these valves will show. The air pressure for atomization is tested for atomization, note being taken whether the pet cocks throw solid oil or atomized oil. The jackets are tested for water and the various overflows from the jackets inspected to make sure that they are all running. The overflow from each individual water cooled valve is inspected.

The engine having been ascertained to be in condition to turn over, the air supply and the oil supply being checked at each injection valve, and it having been positively ascertained that each part of the engine is supplied with water, the engine is ready to start. A look at the gage board shows the pressure of the fuel oil supply, the atomizing air pressure, the starting air pressure, the jacket water pressure and the condition of the various auxiliaries.

Most Diesel marine engines have one set of cams for going ahead and another set on the same shaft for reversing and the shaft is moved end-wise to bring one or the other into play. In order to shift this shaft it is necessary to lift all the valves, otherwise their rollers would catch on the edges of the cams. A lever is provided for this purpose.

STARTING UP

To start a Diesel engine the first step is to lift the valves, the next to shift the cam shaft forward or reverse as the occasion may require—the next is to lower the valves. Another lever is provided which causes the governor, when stopping a Diesel engine, to close off the oil injection valves, otherwise if the engine stopped with one of them open the cylinder would be filled with oil. Incidentally the only way a Diesel engine can be stopped is to shut off the oil supply.

The air valve is opened and the engine starts slowly. It turns more easily even than a steam engine because no warming up is necessary. After it has made about one revolution the governor lever is moved and the injection valves begin to act. The engine develops power instantly with the fresh injection. It is then operated very slowly indeed until the entire engine is well warmed up, because one of the greatest troubles with Diesel engines is the

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cracking of the cylinder castings owing to the constant changes of temperature.

During this period a round of the engine is made to inspect the action of valves, try pet cocks, examine jacket water for temperature and otherwise make sure that the engine is operating sweetly. The engine should have a chance to operate twenty minutes in this manner, but if necessary can be brought up to full speed in four or five minutes, but should by no means be brought up to full speed immediately on start unless there is opportunity to circulate *hot* water throughout the jackets of the engine, as at least one installation has provided a connection from the donkey boiler to the jackets for the purpose of warming them up.

When under way if any of the valves give trouble a good Diesel man thinks nothing of removing them or changing them without stopping the engine. If an exhaust valve or an injection valve must be changed the inlet valve is propped open so that there is no compression in the cylinder and vice versa.

Selection of Fuel

Great care must be exercised in the selection of fuel for these engines, but it would be impossible to make specifications, because a fuel which one engine will use satisfactorily cannot be consumed by another engine having a different compression or system of atomization. It is an object to use the cheapest fuel possible but in a general way Diesel engines absolutely cannot use crude oils. The fuels which they do require are easily obtainable and cost very little more than crude oil. Most Diesel engines, as sold by the manufacturers, are guaranteed to use crude oil of a certain gravity, but this gravity is so high that there are very few crude oils in the world that will comply with it. When an engine is operated satisfactorily on an oil of a given viscosity, it is advisable to get fuel as near this viscosity as practicable, otherwise the entire adjustment of the injection valves must be altered. A still better way is to have a heater installed, possibly taking warm gases from the exhaust for the purpose of heating the oil. A viscometer for use on shipboard can be obtained for about $50.00 (10/8/4), and if the fuel oil happens to have more viscosity than desirable, enough heat can be added to it to bring about the proper consistency.

All told the Diesel is an easy engine to operate for a man who is a mechanic and an engineer, but if undertaken by a tinkerer he is sure to find himself in trouble soon because of the fine workmanship demanded in the proper maintenance of a Diesel engine.

Convention of the American Society of Marine Draftsmen

The fourth annual convention of the American Society of Marine Draftsmen, which was held at the Hotel Breslin, New York, on April 16 and 17, proved to be most successful from every standpoint and eclipsed all previous conventions of the society for the amount of work accomplished and the harmonious manner in which the proceedings were conducted.

The meeting was called to order by J. Emile Schmeltzer, president of the society, at nine o'clock on Friday morning, April 16, and the following delegates answered to the roll: Branch No. 1, Delaware River, R. N. Story; Branch No. 2, Norfolk Navy Yard, A. W. Chase; Branch No. 3, Boston Navy Yard, M. M. Blunt; Branch No. 4, Quincy, Mass., J. E. Buckley; Branch No. 5, Washington Navy Yard, Chas. Walsh and G. W. Nusbaum; Branch No. 6, Newport News, Va., S. Van Auken, A. H. Haag and H. A. Hope; Branch No. 7, Portsmouth Navy Yard, R. J. Boyd; Branch No. 8, Connecticut, A. C. West; Branch No. 9, New York, R. H. Stults and P. R. Hichborn; Branch No. 10, District of Columbia, W. L. Buckley and H. Capdevielle; Branch No. 11, Mare Island, W. B. Newton; Branch No. 12, Bath, Me., W. Murtaugh.

At the morning session the reports of the executive committee, delegates and the several standing committees were heard. The reports showed a healthy growth in membership, new branches having been established at Bath, Me., and Vallejo, Cal. There are, at present, three more branches forming in various parts of the country. The secretary's report showed that a large number of the members had secured positions through the inquiries of employers for men in this profession.

The afternoon session was devoted to unfinished business and the election of officers, which resulted as follows: President, J. Emile Schmeltzer, New York; vice-president, H. A. Hope, Newport News, Va.; secretary, B. G. Barnes, Quincy, Mass.; treasurer, P. K. Thurston, Washington, D. C.; executive committeeman, P. H. Frohwein, New London, Conn.

The Norfolk and Newport News, Va., branches of the society were successful in securing the convention for next year, and it is believed that Old Point Comfort will be designated as the place of meeting.

The second day of the convention was devoted entirely to new business, when various resolutions, having for their object the advancement of the draftsmen along intellectual and economic lines, were introduced and acted upon.

The convention closed with a banquet given in honor of the delegates by the New York Branch at the Hotel Breslin, at which over 200 were present, including men prominent in the field of naval architecture and marine engineering. R. H. Stults acted as toastmaster, and after welcoming the delegates and other guests, introduced the following speakers: J. Emile Schmeltzer, "The Society: Its Organization and Objects"; Luther D. Lovekin, "The Marine Draftsman"; Saunders Van Auken, "Brotherly Love"; Hon. James P. Maher, "Our Navy Yard"; Naval Constructor J. E. Bailey, "Our Battleships"; Postmaster Wm. E. Kelly, "Organization and Fraternalism"; and Hon. James V. Flynn, "In Passing." The banquet was a splendid social success and the festivities continued long after the formal programme was completed.

The object of the American Society of Marine Draftsmen, as outlined by the officers, is to unite the marine draftsmen and to promote their welfare socially, intellectually and professionally and to cultivate the highest standard of professional ethics. Meetings are held by the various branch societies at least monthly, and, together with the regular business, papers of a technical nature are read and discussed. These papers are published in the society's *Journal*, which makes its appearance quarterly, and, while it is only one year old, it has already taken a front rank among technical papers of its kind.

While the society is distinctly an intellectual body, yet the collective mind of the draftsman seems to have been asleep to general economic conditions until quite a recent date. It is only recently that he has awakened to the fact that he is his brothers' keeper, and anything he may do to benefit his brother draftsmen will not only react to his own good, but will advance the interests of every member of the profession. Through this organization draftsmen learn to know and respect each other, and by association and the interchange of professional ideas increase their efficiency, which in turn reacts to the benefit of the employer.

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Notes on the Conversion of Cargo Vessels into Bulk Oil Carriers—II

BY F. K. RUPRECHT *

TANK TOP

It would be impossible to retain the tank top intact in an oil vessel, owing to the leakage and collection of explosive gases which would make the vessel very dangerous. Large openings could be cut in the tank top and all parts liable to collect vapors opened up by air and drain holes. This method, however, is not satisfactory because it is very difficult to clear the intact sections of gas. It would also be impracticable to remove the entire tank top, because it is a very valuable strength member, and longitudinal strength is a great desideratum in oil-carrying vessels.

A method which, it is believed, would do away with the first objection and still leave a great amount of strength, is to remove all plating except a strip on the centerline keelson wide enough to take the vertical web stiffeners on the centerline bulkhead, and strips 8 to 12 inches wide on each keelson and on the margin plates. A strip one frame space wide can be left on one side of the transverse bulkheads. This forms the lowest horizontal stiffener to the bulkhead and therefore should be on the same side as the other horizontal stiffeners. This method will apply to the tank top throughout the oil tanks and cofferdams. In this arrangement we keep that part of the tank top which contributes most towards the strength of the vessel and does away with any pockets and ventilation troubles.

CONSTRUCTION OF WEB FRAMES

Two web frames will be fitted in each tank. In some cases the old web frames will be found adequate, and in this case no others need be fitted. In some of the tanks the web frames will not be found in a location suitable and in this case new ones will be added at the required frames.

The cost item will be the ruling one in the construction of these web frames, and it is believed that the cheapest construction is a single straight or tapered plate riveted to the margin plate bracket. The idea of tapering is to insure a good connection to the bracket. At the ends of the vessel the webs will be made up of two plates, because they could not be fitted in one length owing to the slope of the ship's side. The plate butts and the connection to the bilge bracket will be triple riveted. The connection to the shell will be by the ordinary frame bar and a 3½-inch by 3½-inch by ½-inch angle will be fitted on the other side. The larger angle will be double zigzag riveted and the smaller angle will take the outside row only. The face bars will be double bulb angles about 3 inches by 7 inches, giving a good heavy frame. One of the bars will be bent into the margin bracket and the other carried down over the butt, as shown in Fig. 5.

At the deck the web frame will be clipped to the deck by double clips and riveted oiltight, besides being bracketed to a deep beam, which in turn will be connected to a web on the centerline bulkhead. This forms two complete girders in each tank and gives a great amount of stiffness. Where the original web frames are retained special construction must be used to arrive at the same amount of strength. Web frames may have lightening holes cut in them, and where the straight plates are used this will usually be advisable, owing to excess weight.

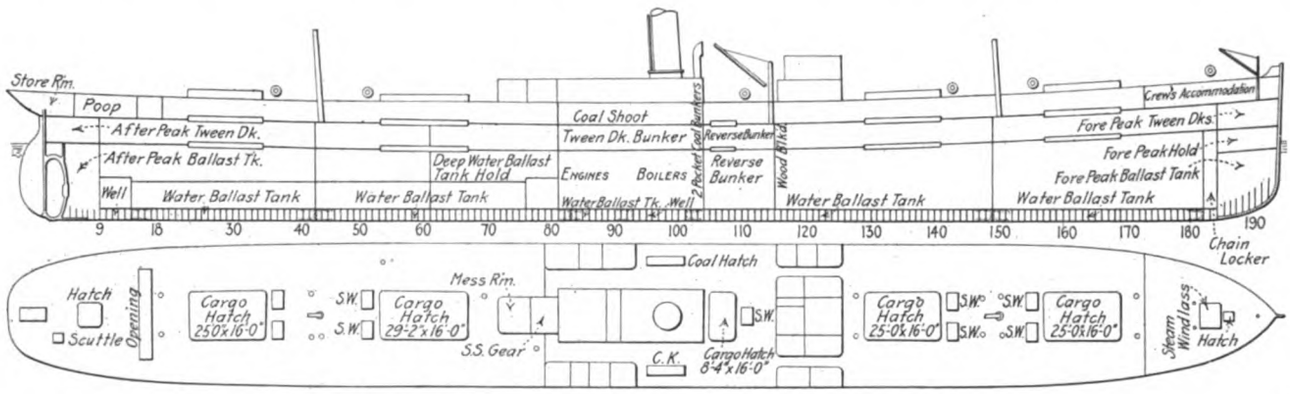

Fig. 1.—General Arrangement of Cargo Vessel Before Conversion to Oil Carrier

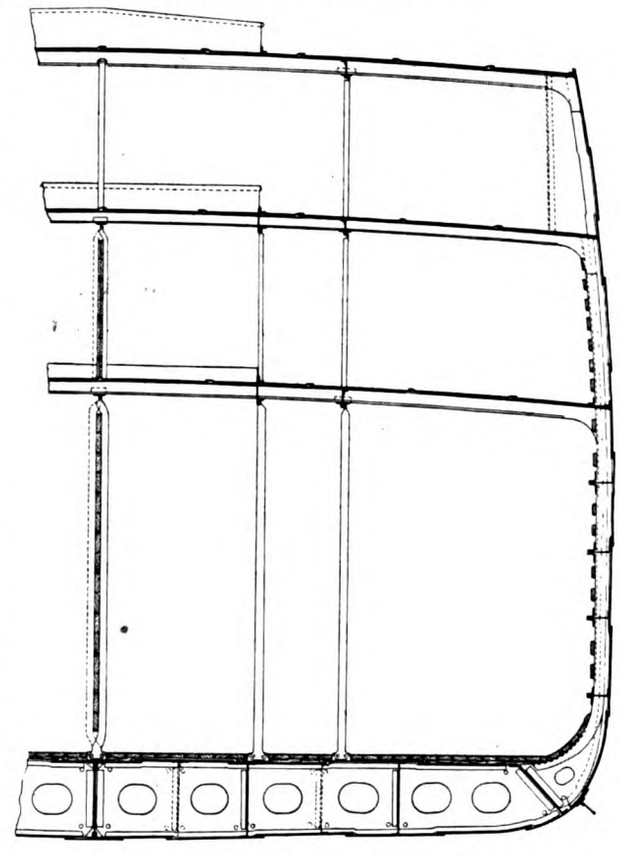

Fig. 2.—Midship Section of Cargo Vessel

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The above method of constructing web frames recommends itself because of the small amount of riveting owing to the fact that most of the webs are in one piece. There is a saving in scrap material because no radii have to be cut at the bilge and at the inner edge of the plate. The old bilge bracket need not be removed and the face bars need very little, if any, furnacing. If, however, it is thought advisable to take out the old bilge bracket, the webs can still be fitted in straight lengths with a radius at the bilge. By fitting them this way the width will exceed that required by the registration societies, but a saving will be made in labor on the plate because of not having to shape the inner edge or furnace the face bars. The web will be connected to the margin plate by double clips and the riveting will be through the floor clips doubled if necessary.

In the 'tween decks the webs will be a flanged plate and will be riveted to the old shell bar and double or single double riveted clipped to the oiltight main deck and to the upper deck. Only the former clips will have to be riveted and calked oiltight, unless the 'tween decks are used as summer tanks.

TANK DECK

The tank deck will be oiltight from ship side to expansion trunk side. To do this the main frames must cut at the deck level, as stapling the deck angle around the frames would not be in accordance with the rules of the regis-

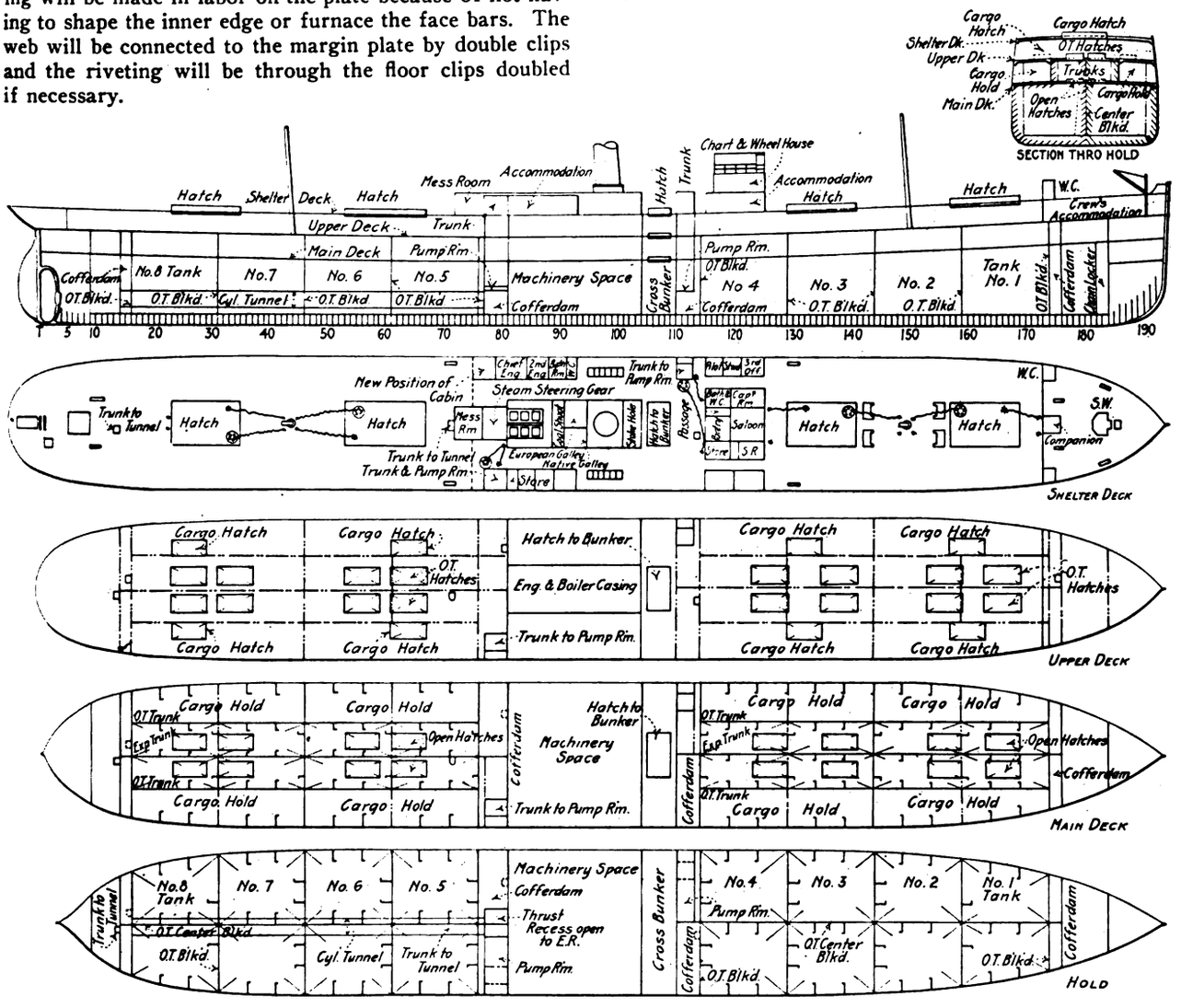

Fig. 3.—General Arrangement of Vessel as Bulk Oil Carrier

All stringers will be cut in the way of the webs, and if of a smaller depth will be bracketed to them. The brackets will have double clips to the web plate and will be double riveted to the stringer plate. These brackets may be flanged or fitted with a single face angle. If the stringers are of the same depth as the web frames, the stringer will be double clipped to the web or single clipped, but double riveted, which is preferred, and half diamond plates will be carried over the web frame face angles The old stringers will be used, but will have to be taken down and cut to suit the bulkheads and frames. The brackets may be fitted to them while on the ground and the stringers replaced in section and reriveted to suit work.

tration societies and would not insure permanent tightness. The most economical method of doing this is to take the stringer plate off the deck and shear off the edge that had been notched in way of the frames. This takes about 6 to 8 inches off the plate. A section of the frame will be removed for about 10 inches above the deck level to allow for riveting the deck to the shell. The sheared stringer plate can now be connected continuously to the shell by a large double zigzag riveted angle or by a flanged plate. The latter will be easier to fit and rivet because the lap to the deck will be clear of the frames and easier to rivet and calk. With the flange plate it will be found easier to secure an oil tank connection to the shell, because the latter will be found slightly unfair and the flange plate

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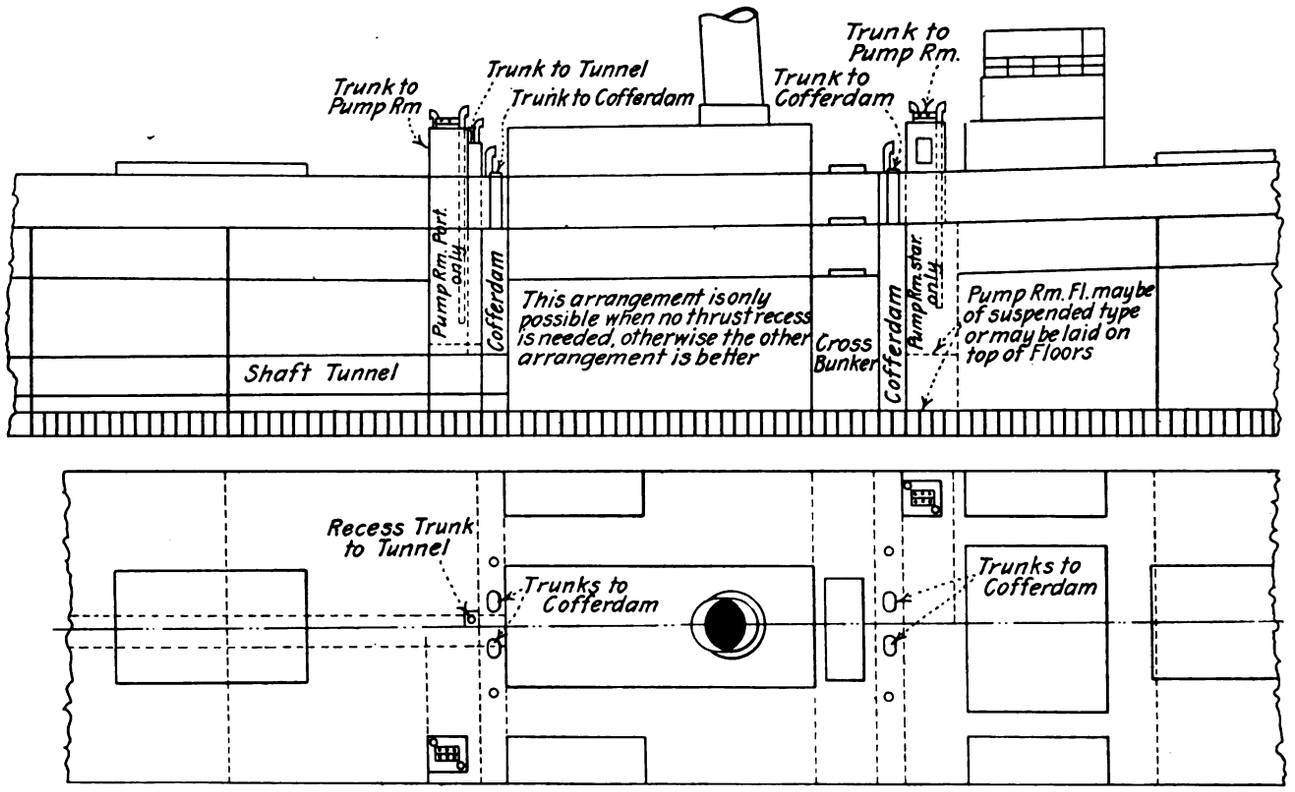
Trunk to Pump Rm
Trunk to Tunnel
Trunk to Cofferdam
Trunk to Cofferdam
Trunk to Pump Rm.
Pump Rm. Port. only
Cofferdam
This arrangement is only possible when no thrust recess is needed, otherwise the other arrangement is better
Cross Bunker
Cofferdam
Pump Rm. Star. only
Pump Rm. Fl. may be of suspended type or may be laid on top of Floors
Shaft Tunnel
Recess Trunk to Tunnel
Trunks to Cofferdam
Trunks to Cofferdam

Fig. 4.—Alternate Arrangement of Pump Rooms and Midship Cofferdams

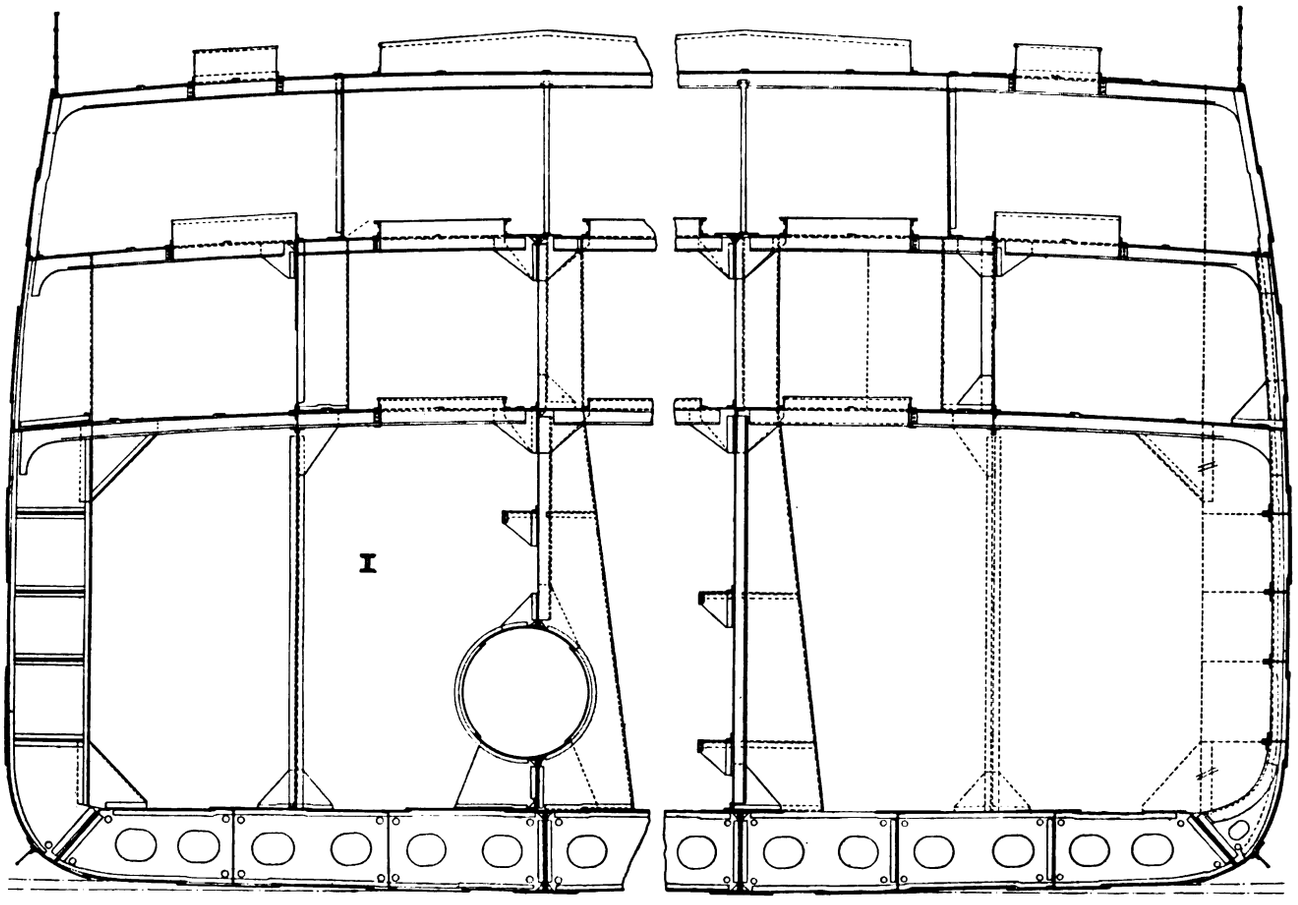

Fig. 5.—Midship Sections of a Cargo Vessel Converted into a Bulk Oil Carrier

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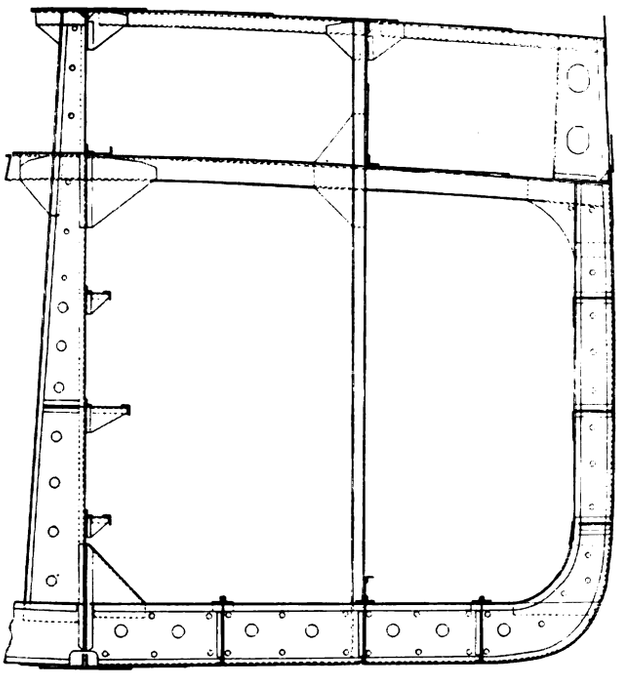

Fig. 6.—Midship Section of Vessel Built for the Oil-Carrying Trade

can be pulled up to it by the rivets better than a heavy angle. The angle connection reduces the width of the stringer plate, while with the flanged plate the original width can be retained by making the horizontal flange any desired width.

make up the width lost by the double riveted edge laps. Three strakes will, as a rule, be ample for the space between shell and trunk bulkhead. The stringer plate will be the original plate and so will be next, but a new strake will be fitted to take the trunk bulkhead. The edges must not be joggled because of the rules of the registration societies, so that in some cases the original plates must be put through the rolls before marking for the new rivets.

It will now be necessary to decide what to do with the deck in the expansion trunk. It can be left as it is and hatches cut in it to correspond with the oil hatches on the upper deck, the old cargo hatches being plated over, or the deck may be entirely taken up. In the latter case the beams may be left continuous to the centerline bulkhead and bracketed to the latter or cut at the expansion trunk edge. In this case, if the trunk bulkhead is stiffened on the oil side, the beams will project beyond the bulkhead far enough for a bracket connection from the vertical stiffeners on the bulkhead, or, if desired, the beams may be cut at the bulkhead line and the vertical stiffeners extended below the deck level far enough for a bracket connection to the beams as shown in the sketches. If the deck is stopped at the trunk the connection to the trunk bulkhead may be made by a large angle double zigzag riveted, or by a flanged plate similar to the connection at the shell. Since the bulkhead and the deck strake are new work the angle will be found very satisfactory.

If the deck is left intact, the vertical stiffeners on the expansion trunk bulkhead will be bracketed to the deck. If the deck is entirely removed, we introduce the complication of having to make the centerline and all transverse bulkheads continuous to the upper deck in the expansion trunk. What would seem a good compromise, since it includes the advantages of both methods, is as follows:

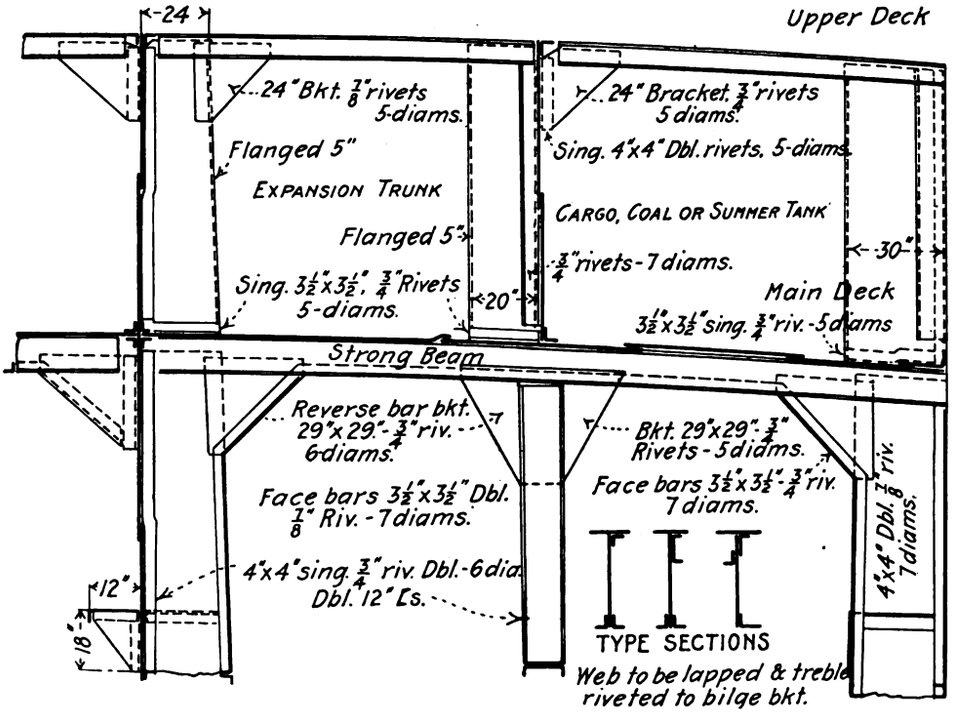
24"
Upper Deck
24" Bkt. 7/8" rivets 5-diams.
24" Bracket. 3/4" rivets 5 diams.
Flanged 5"
Sing. 4"x4" Dbl. rivets. 5-diams.
EXPANSION TRUNK
CARGO, COAL OR SUMMER TANK
Flanged 5"
3/4" rivets-7 diams.
30"
Sing. 3 1/2"x3 1/2", 3/4" Rivets 5-diams.
20"
Main Deck
3 1/2"x3 1/2" sing. 3/4" riv.-5 diams
Strong Beam
Reverse bar bkt. 29"x29"-3/4" riv. 6-diams.
Bkt. 29"x29"-3/4" Rivets-5 diams.
Face bars 3 1/2"x3 1/2" Dbl. 7/8" Riv.-7 diams.
Face bars 3 1/2"x3 1/2"-3/4" riv. 7 diams.
4"x4" sing. 3/4" riv. Dbl.-6 dia.
Dbl. 12" Cs.
12"
18"
4"x4" Dbl. 7/8" riv. 7 diams.
TYPE SECTIONS
Web to be lapped & treble riveted to bilge bkt.

Fig. 7.—Section in Way of Web Frames, Showing Proposed Construction

Since this deck must be oiltight to the expansion trunk, all butts and laps will have to be double riveted. As a rule the original deck will be single riveted, so that all plates must be taken up and repunched for these extra rivets. The alternate strakes, of course, will have to be new plates to Beams cut for centerline bulkhead, but left continuous from shell to centerline; deck made oiltight as outlined above, but continued beyond the expansion trunk bulkhead far enough to form a shelf about 2 feet wide for the connection of the stiffener brackets and the web stiffeners.

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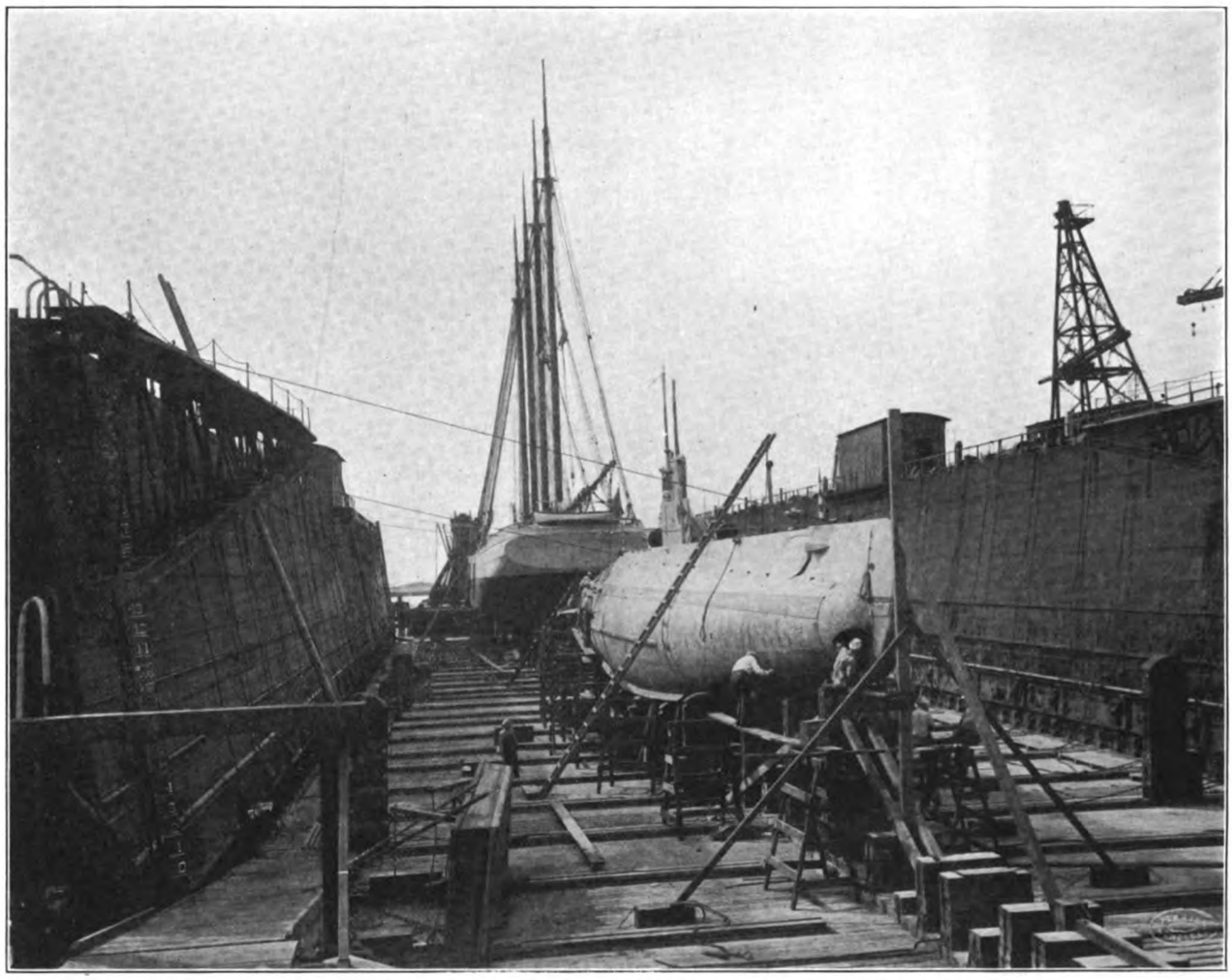

United States Submarine *F*-4 in Honolulu Drydock Just Before Starting on Her Fatal Cruise

This ledge would be carried entirely around the tank, forming a connection for the longitudinal and transverse bulkheads and the brackets of their vertical stiffeners, which will be cut at this level. At the centerline the shelf will be about 2 feet on each side of the bulkhead and the beam ends will be riveted to it and bracketed to the vertical stiffeners on the bulkhead. A corresponding strip of plating will be riveted to the strong beams, thereby increasing their stiffness. Small drain holes will be cut between all brackets all the way around the tank to avoid the collection of small quantities of oil. A large face angle will be riveted to the ledge to increase its stiffness, except at the transverse bulkheads, where the plating will be riveted to the next beam on each side.

Lloyd's rules for tank vessels require this shelf of plating at this level, two frame spaces wide at the centerline, for the connection of the centerline bulkhead and stiffener brackets and one frame space wide each side of the transverse bulkheads. None is, however, required at the trunk side, but the fitting of it seems to justify itself on a conversion job by the simplification of construction. In tank vessels only the strong beams in line with the web frames are carried to the centerline bulkhead, but in a conversion job where we have the beams we can get a stronger and cheaper job by keeping them in place.

While the deck plating is a great factor in longitudinal strength, we can afford to remove such large sections of this deck, because it is located close to the neutral axis of the vessel, and so the few strakes removed have but little effect on the moment of inertia, and the slight amount lost is more than made up for by the four angles on the centerline bulkhead, the face angles on the ledges, and the expansion trunk angle, all of which are continuous members.

(To be continued.)

Loss of Submarine F-4

Through the courtesy of Mr. James A. Lyle, superintendent of the Honolulu dry dock of the Inter-Island Steam Navigation Company, we are able to show on this page what is probably the last photograph ever taken of the United States submarine *F*-4 before she took her fatal plunge outside of Honolulu harbor on March 25. The submarine is shown docked in the Honolulu dry dock with the four-masted schooner *Defender*, receiving a final overhauling before beginning practice maneuvers.

According to reports from the commandant of the naval station at Pearl harbor, the salvage operations have progressed slowly, due to the depth at which the *F*-4 is submerged. Although nothing definite is known regarding the cause of the disaster, it is surmised that the crew must have been the victims of an explosion within the ship, as no signals of any kind were given after the vessel took her fatal dive.

The loss of the *F*-4 is the first serious submarine disaster in the United States Navy. The records at the Navy Department show, however, that the total number of submarine disasters in other navies up to date is sixteen.

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The Craig Diesel Type Marine Oil Engine

Description of a Four Cycle Diesel Engine, Distinctively American in Design and Construction—Its Application to Commercial Boats

Sufficient data are now available from a variety of sources to show with a fair degree of certainty what can reasonably be expected from the performance of well-designed Diesel marine oil engines. The shortcomings and limitations of this type of machinery are much better understood than was the case a few years ago, and, on the other hand, the exceptional advantages of the Diesel engines are becoming more fully recognized and the field for its development is rapidly widening.

At the present time the superiority of the four-cycle Diesel engine is generally acknowledged, and its continued success, as marked by the increase of orders in England and on the Continent for vessels equipped with this type of machinery, seems fully assured. In the United States, where a general policy of "watchful waiting" has been adopted by shipowners in the matter of investigating the merits of the Diesel engine, a few pioneers have taken matters into their own hands, and in spite of the seemingly hostile attitude of shipowners have worked out their own designs and built engines of this type which have given very creditable results in service and which are likely to become an important factor in the marine engine field.

One of the distinctively American Diesel marine engines is illustrated on this and the following pages. It is of the four-cycle type built by the James Craig Engine & Machine Works, Jersey City, N. J., and shows in every detail the same thoroughness in design and workmanship that has marked the large gasoline (petrol) engines developed so successfully by this firm. The particular engine illustrated is a six-cylinder unit with a bore of 9½ inches and a stroke of 11 inches, designed to develop 175 brake horsepower when operated at about 400 revolutions per minute.

Two six-cylinder engines of this size were installed last season in the motor boat *Aeldgytha,* built by the Matthews Boat Company, Port Clinton, Ohio, from designe by Morris Whitaker, Nyack, N. Y., for cruising purposes on the Great Lakes. The boat is 110 feet long overall and 18 feet beam, with a draft of 6 feet. This is the first twin screw Diesel engine installation made in the United States.

During the last season the *Aeldgytha* cruised 2,400 miles with a fuel cost of only $120 (£25), whereas during the previous season, when the boat was fitted with gasoline (petrol) engines and made a total run of only

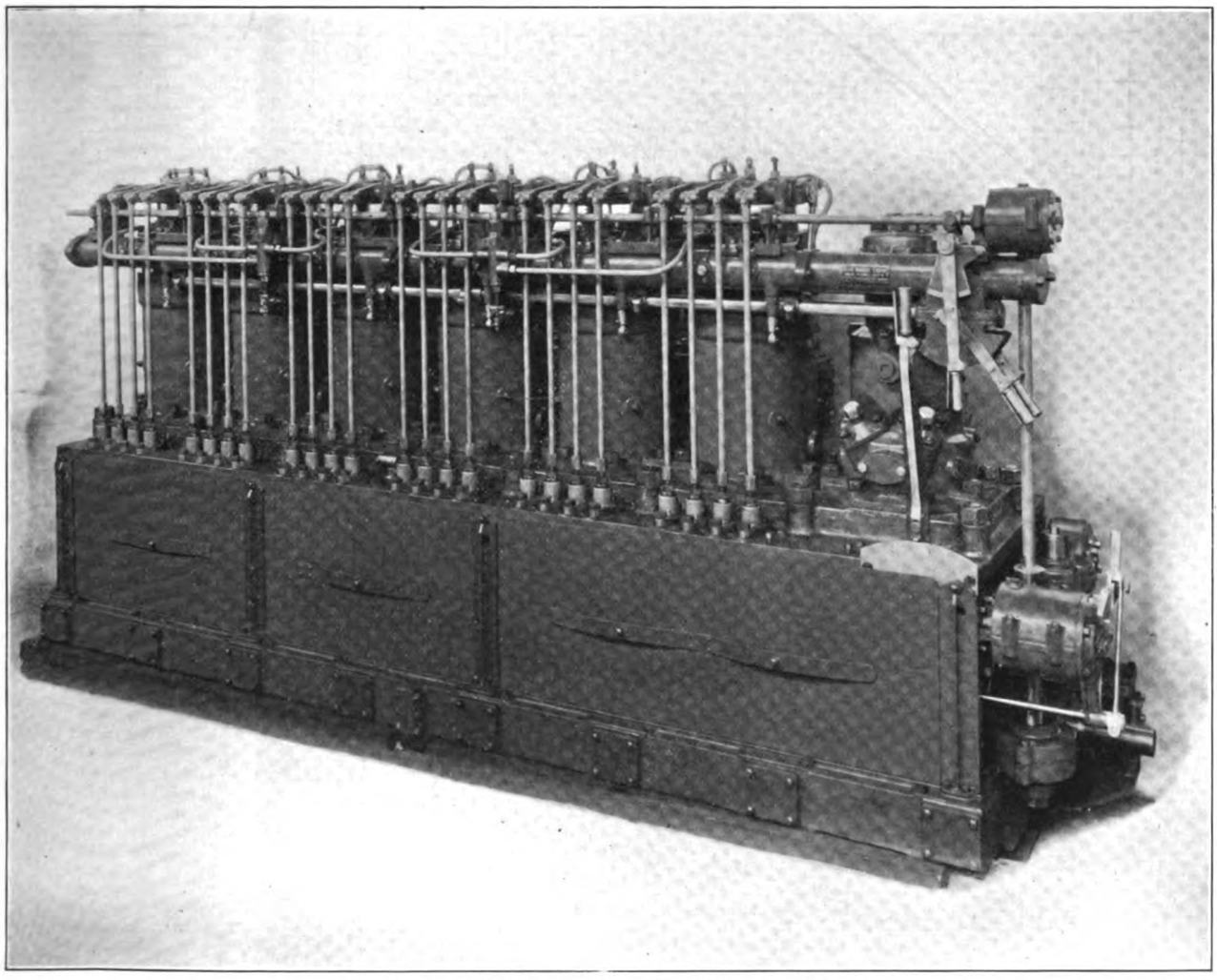

Fig. 1.—Craig Six-Cylinder Diesel Type Marine Oil Engine

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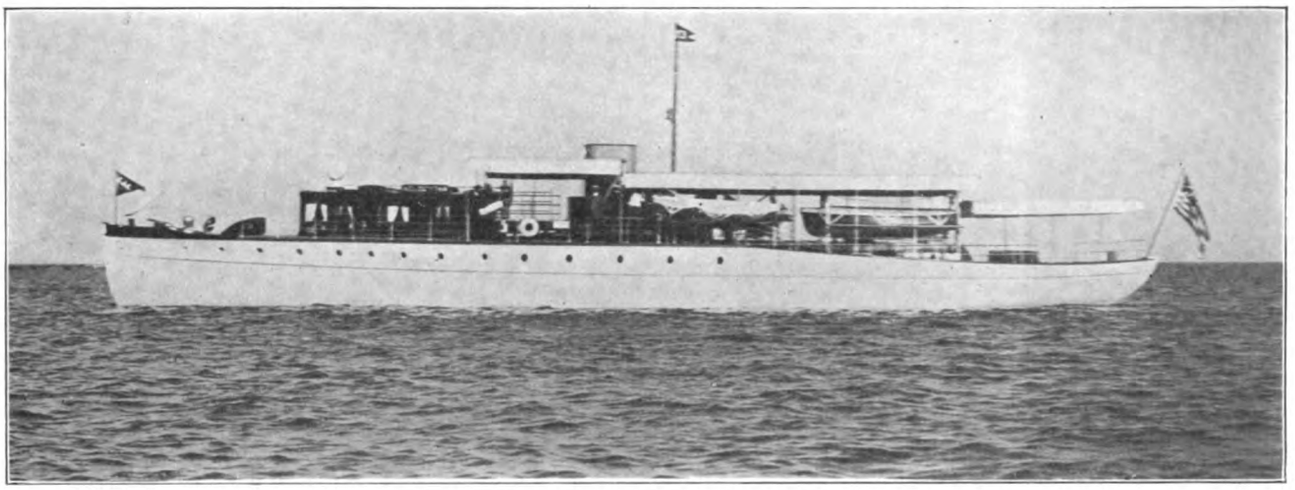

Fig. 2.—Diesel-Engined Motor Boat *Aeldgytha*

1,600 miles, the fuel cost was $550 (£113). With the Diesel engine installation the total cost for fuel and lubricating oil for the 2,400 miles traveled was only $175 (£36). The average fuel consumption with the engines running at about 330 revolutions per minute and giving the boat a speed between 11½ and 12 miles per hour, was a little less than one gallon per mile, or about .5 pound per brake horsepower per hour. By installing Diesel engines the cruising radius of the boat was more than doubled and the danger attending the presence of a large quantity of gasoline (petrol) on board was wholly eliminated.

The Craig engine has a number of very desirable features incorporated in its design. The framing is built up of steel columns carried down through the bedplate and

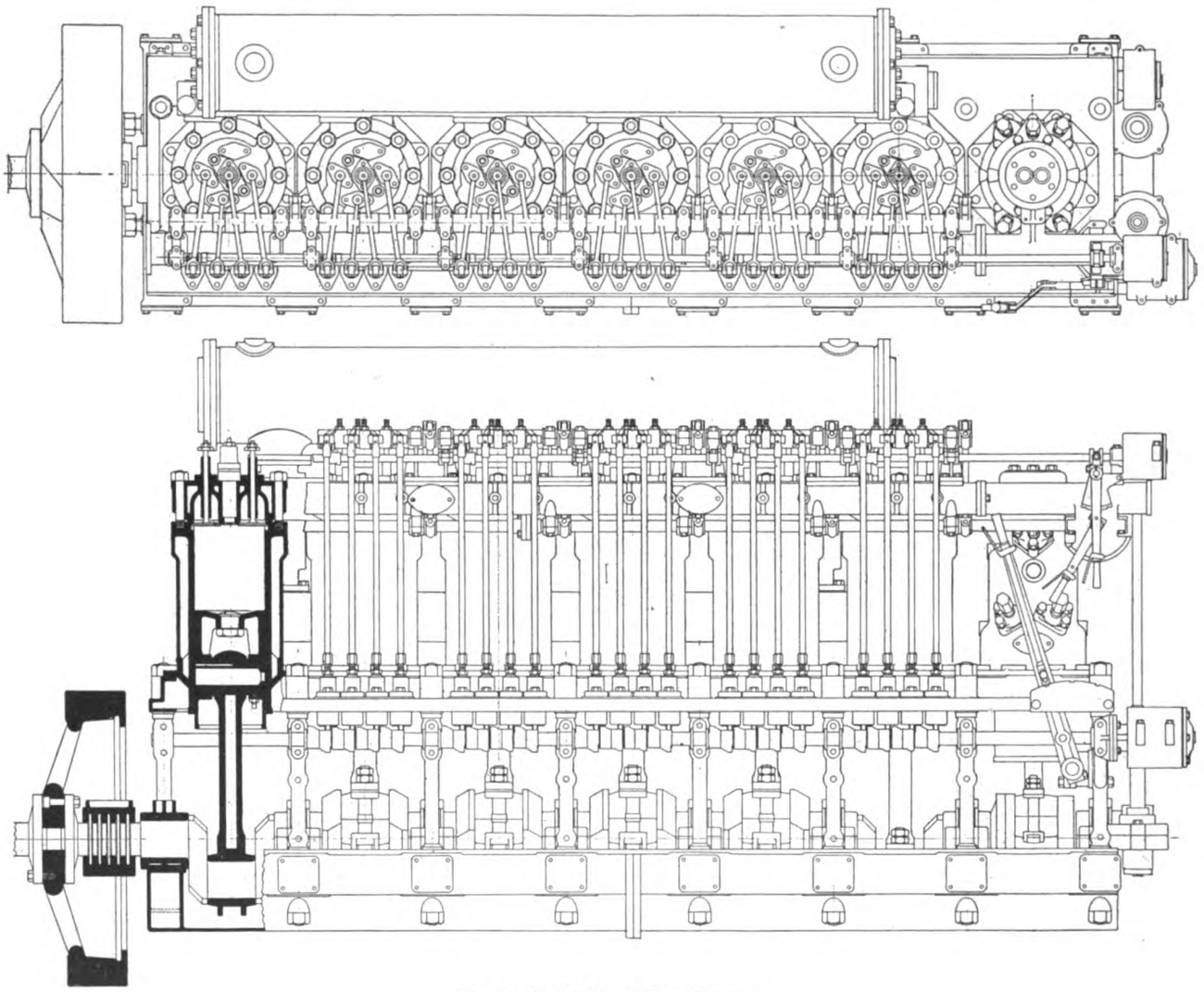

Fig. 3.—Craig Diesel Type Engine

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stayed with diagonal bracing. The bedplate is a steel casting with hollow box girders through which the water for cooling the cylinder walls and heads and the main bearings is circulated. Above the column framing is an upper or "super" base carrying the cylinders and valve push rod guides.

In handling the exhaust a very ingenious arrangement is used consisting of an auxiliary exhaust valve operated by a separate cam shaft so timed that the valve is opened before the piston uncovers the exhaust ports in the cylinder walls at the bottom of the stroke. In this way over 80 per cent of the exhaust gases at high temperatures pass out of the cylinder before the regular exhaust valve in the cylinder head is opened. The regular exhaust valve, therefore, is not opened against high-pressures, nor is it subjected to highly heated gases; its function is simply to permit scavenging the cylinder.

With the exception of the auxiliary exhaust valve, all of the valves are mounted in the cylinder head. The air inlet valves are operated in the same way as the exhaust valves, but they are all connected to a common manifold which can be connected to the bilges, thus aiding in ventilating the bilges and at the same time supplying cold air to the cylinders. The air-starting and fuel injection valves are operated in a similar manner, but their rocker arms are mounted on eccentrics carried on a fore and aft shaft which by partial rotation will throw either one or the other of the valves in or out of action, as may be desired, in starting the engine. The fuel valve itself opens downward and the oil and injection air are thoroughly mixed and atomized in a series of washers perforated with small holes surrounding the valve.

Reversing is accomplished in the usual manner by shifting the main cam shaft, bringing the proper cams into action. In starting the engine, the air-starting and fuel injection valves are controlled by two levers connected by gearing to two control shafts, one mounted outside the other in the form of a sleeve, each of which controls the valves for three of the cylinders. A single oil pump supplies the oil to all injection valves, the openings in the separate feed pipes being controlled by separate needle valves and check valves.

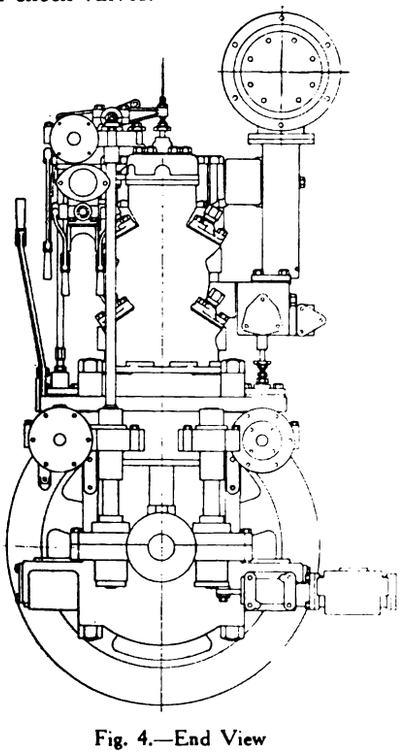

Fig. 4.—End View

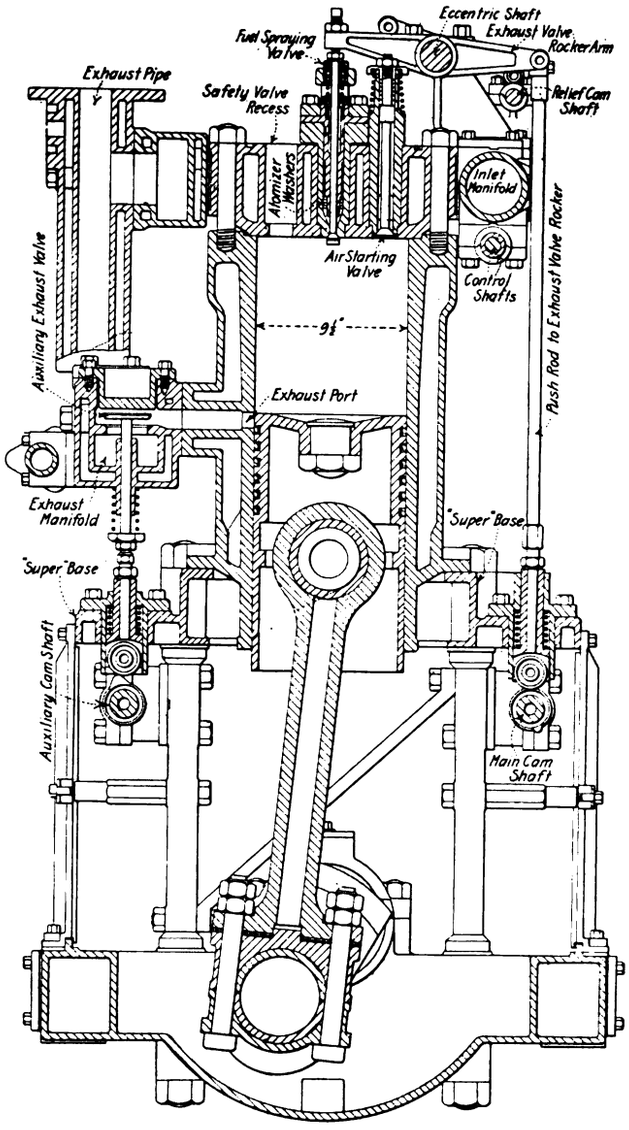

Fig. 5.—Cross-Section

The air compressor is of the two-stage type mounted on the main crankshaft with a very effective system of intercoolers. The builders also supply an auxiliary gasoline (petrol) engine-driven set comprising a two-stage air compressor, an electric generator and a bilge pump.

While from the point of view of economy and safety this type of engine is well adapted to yacht and pleasure boat service, as instanced by the satisfactory performance of the twin screw installation on the *Aeldgytha*, nevertheless its greatest field of application will undoubtedly be in commercial boats. Here the economy in fuel consumption, averaging not over .5 pound per brake horsepower per hour, coupled with the reliability of performance which can be justly claimed, makes it possible for a motor vessel to undertake long voyages without refueling, thus giving the owners an opportunity to take advantage of favorable markets for the supply of fuel. Moreover, in the case of the Craig engine, simplicity of design in accordance with the best engine building practice has made it possible to put the engine on the market at prices that compare very favorably with those of steam power plants, and in accomplishing this it is believed that one of the most serious drawbacks to the adoption of Diesel engines in commercial boats has been overcome.

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Weights of Solid Four-Blade Propellers

The writer had occasion at one time to collect some data on the foundry and finished weights of various solid, four-blade, cast iron, bronze and cast steel propeller wheels. As complete dimensional data accompanied these weights, it seemed as though a law or formula might be developed which would give with sufficient accuracy the weight of a wheel for both cost-estimating and design purposes. After several different formulæ were tried, the following was finally adopted as giving the most accurate approximation, and still not being unwieldy.

The foundry or rough weights were plotted on:

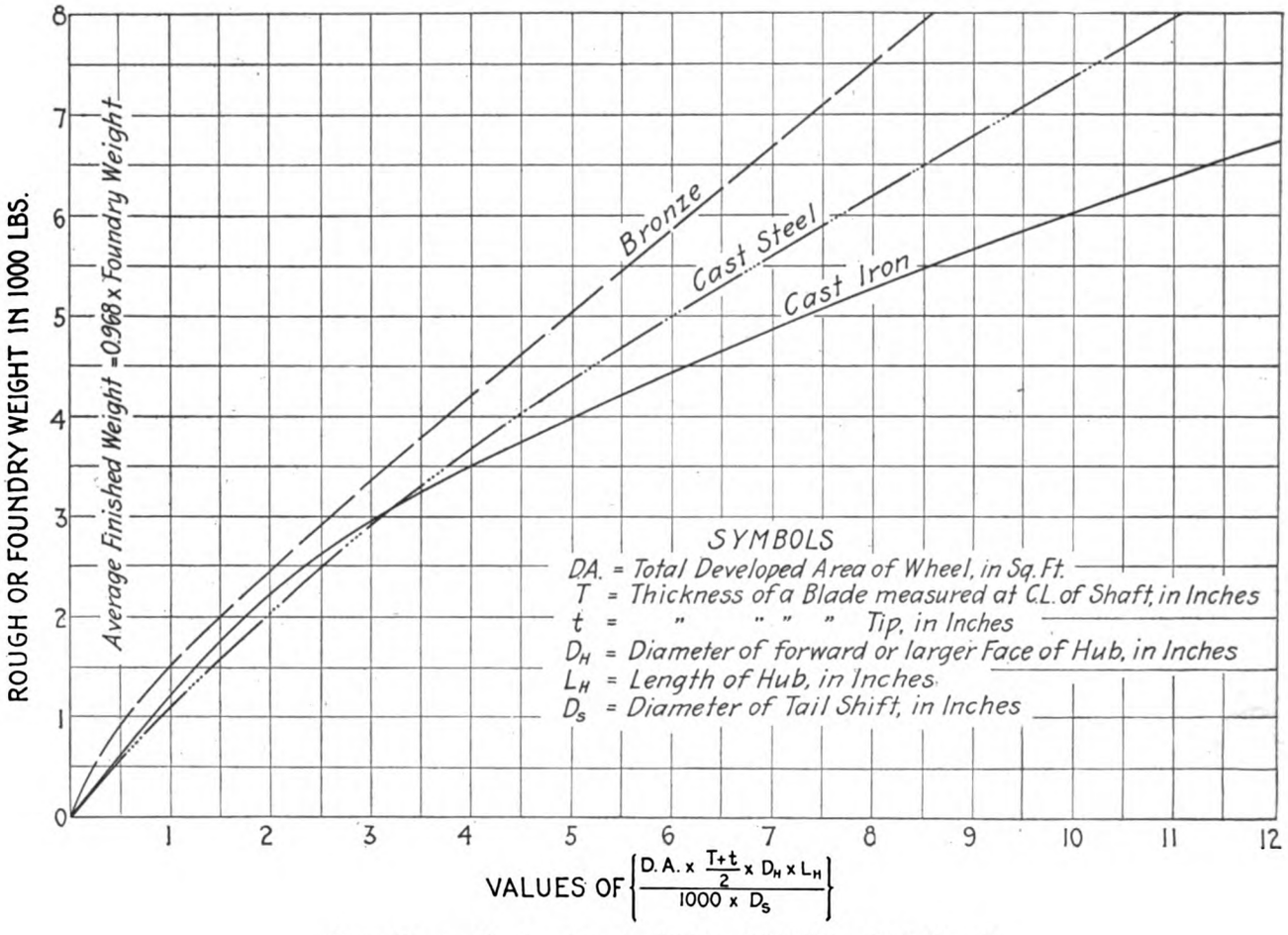
$$\frac{DA \times \frac{T+t}{2} \times L_h \times D_h}{1{,}000 \times D_s},$$

where DA = total developed area of wheel, in square feet.
T = thickness of a blade measured at center line of shaft, in inches.
t = thickness of blade tip, in inches.
D_h = diameter of forward or larger face of hub, in inches.
L_h = length of hub, in inches.
D_s = diameter of bore for shaft at forward or larger face, in inches. Appraximately equal to the diameter of the tail shaft, in inches.

The foundry weights, or the weight of the wheel when turned out from the foundry ready for machining and boring, were used, as the finished weights varied much more, depending on the amount of machining done, and on the size of the cap fitted, etc. It was found that as a general average the foundry weight was about 3 percent greater than the finished weights when no caps were fitted. The foundry weights also varied somewhat, however, due to the difference in ramming in the foundry. Two 4,000-pound wheels (cast iron) cast from the same pattern, but rammed by different molders, were found to differ by 240 pounds. So it is very probable that a curve plotted on this formula will come within the limits of uniformity of actual weights.

The factors going to make up this formula are those found on practically every wheel design. Three curves are shown; one for cast iron wheels, one for bronze, and one for cast steel wheels. Although the writer had not the available data, no doubt the weights of built-up wheels and also three-blade wheels could be plotted on this same base. It is advised that any readers having sufficient data actually plot their own results, to allow for any variations in weights due to any local standards in design.

Seattle, Wash. L. A. BAIER, N. A.


ROUGH OR FOUNDRY WEIGHT IN 1000 LBS.
Average Finished Weight = 0.968 x Foundry Weight
Bronze
Cast Steel
Cast Iron
SYMBOLS
DA. = Total Developed Area of Wheel, in Sq. Ft.
T = Thickness of a Blade measured at C.L. of Shaft, in Inches
t = " " " " Tip, in Inches
D_H = Diameter of forward or larger Face of Hub, in Inches
L_H = Length of Hub, in Inches
D_s = Diameter of Tail Shift, in Inches
VALUES OF $\left\{\frac{D.A. \times \frac{T+t}{2} \times D_H \times L_H}{1000 \times D_S}\right\}$
0
1
2
3
4
5
6
7
8
9
10
11
12

Curves Showing Rough or Foundry Weights of Solid Four-Blade Propeller

LONG NON-STOP RUN OF MOTOR SHIP.—The motor ship *Selene*, of the Anglo-Saxon Petroleum Company, Ltd., fitted with Werkspoor Diesel engines, recently made a non-stop run of approximately 9,000 miles from Panama to Tientsin in forty-four days, averaging a speed of 200 miles per day. The vessel left Cardiff December 19, arriving at Port Arthur January 13. After loading, she left Port Arthur January 21 and arrived at Colon January 28, leaving Panama for Tientsin January 30. The latter part of the voyage was made without touching at any intermediate ports.

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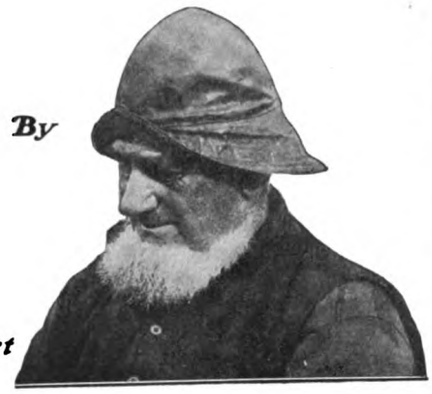
Economy Talks By "Old Scotch"



Savings That Can Be Made When a Vessel is in Port

There is an old saying that "Charity begins at home," and our old friend, Economy, likewise should begin at home. That is, don't practice it while you are away all the time, and neglect it at your home station.

To get down to what I'm aiming at, in connection with economy on board ship, all the saving should not be made while the ship is underway, but it should be practiced while tied up at the wharf, or at anchor as well. Even if the big mill is stopped, there are certain auxiliaries which must be kept going under all circumstances, and they require steam. Hence, fires must be maintained in at least one of the boilers, and that takes coal, and a lot of it, too, unless you carefully watch your corners to reduce waste.

Generally, when using one of the main boilers for auxiliary purposes, you do not need its full power for the work to be performed. Here is where you can make a saving. If it's a Scotch boiler with three furnaces, you can generally get along with the fire in only one furnace, or perhaps you might find it better to use one-third of your grate surface in each furnace. Whichever way you do it, stop all your air inlets, except those through the grate bars, immediately under the spread fire. You don't want to waste your heat units by raising the temperature of a lot of surplus air. Hence, go around and stop up all chinks where the air might sneak in with little dabs of fire-clay, and you will be surprised to see how you can cut down the coal consumption.

When I was a boy I knew the skipper of a Down East schooner who came pretty near being the "King of Tight Wads." He actually would save his used quids of chewing tobacco, stick them up over the galley range, and when they were dry he would put them in his pipe and smoke them. Now I don't believe in carrying economy quite that far, but I do know of several chief engineers who are using the lumpy parts of the ashes from the ash pits over again, and get considerable heat out of them, and that's no joke, either. If you don't believe it, just try it the next time you are tied up at the wharf and don't have to force your fires much. There are a good many unconsumed pieces of coal which sneak through your grate bars, in spite of all precautions, and it's these shirkers that you make use of by "zweibaching" (if I dare use that German term) the ashes.

There are also some economies that can be made in the use of steam, when the vessel is tied up. Of course, you have to run a dynamo to keep the ship lighted, and no matter whether there are many people on board or not, in cold weather you have to keep the ship thoroughly heated throughout. If you didn't, there would be a bill for "busted" pipes, which would freeze up during cold spells.

A friend of mine got up a very ingenious method of avoiding the running of the air and circulating pumps while in port. These require attention and oil, besides being heavy steam users. Then, too, he had to run his flushing pump for the sanitary system. By making a short connection between the auxiliary exhaust pipe to the steam pipe leading to the steam heating system, he shunted all of the exhaust steam from the dynamo engine and the flushing pump into the steam heating system, thereby side-stepping the use of the main condenser and the necessary pumps in connection with it.

At first blush you might think that the back pressure in the dynamo engine and the flushing pump would cause these auxiliaries to use more steam than would be saved by avoiding the use of the air and circulating pumps, but, as a matter of fact, after careful trial, he found that he saved some coal by adopting this method. The increased steam consumption, on account of the back pressure, was more than offset by the live steam he would have used in the air and circulating pumps and in the steam heating system. Of course the drains from the heating system put hot water into the feed tank to be pumped back into the boiler, thereby saving some of the wandering heat units which have but one object in life, and that is to escape. By this method he made the radiators act as an air condenser for the exhaust steam, at the same time they were heating up the quarters on the ship.

On some ships lying at the wharf I have noticed a steady stream of exhaust steam coming out of the escape pipe. Chief engineers who let steam escape that way ought to be "pinched" for robbing the coal mines, as it is a sinful waste of fuel. If you had gone aboard any of these ships, you would, undoubtedly, have found that they were using live steam from the boilers for heating the ship.

Some scientific gents have figured it out that there is only enough coal in sight to last the world at large about one hundred and fifty years. While many of us are not much worried about what will happen to marine engineers when the coal does give out at that time, we are occasionally jolted by the bills presented by the fellows who are digging out the coal these present days.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT*

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Depth at Which Submarines Operate

Q.—How far below the surface can a submarine operate and still see above the surface? B. C.

A.—Periscopes are usually 15 feet to 17 feet in length, and this is the limit to which a submarine can submerge and operate by sight.

Quality of Soft Coal

Q.—Is there any way of readily telling whether soft coal is good coal or bad coal when it is delivered on board ship? CHIEF.

A.—None, so far as I know. In general, good coal has a bright, clear luster and it should not be finely and uniformly broken up; there should be lumps in it of clear, bright coal. If coal is purchased in quuantity and continuously, it will usually pay to have a sample tested for calorific value, which can be done at small expense by many laboratories especially equipped for this work.

Chattering of Safety Valves

Q.—Can you tell me why it is that safety valves sometimes vibrate badly when blowing off steam, and in other cases where the pressure is the same do not chatter? S. V.

A.—The question of the chattering of a safety valve against its seat when discharging is, according to best information, attributed to the length of pipe between the safety valve and the boiler. This should always be the shortest possible. Where it has appreciable length it serves as a reservoir and the enclosed steam has a weight of its own and a natural period of vibration which may synchronize with the natural period of the valve spring in such a way as to cause violent chattering. The best way to stop an action of this sort is to shorten up the pipe connecting the safety valve to the boiler.

Requirements and Pay for a Position as Oiler

Q.—What are the requirements to get a place as oiler in the engine room of ocean steamers, and what is the average pay? E. M. C.

A.—Steamship companies differ as to the requirements imposed upon prospective oilers. In some companies the oilers are chosen from the fire-room force and become oilers via water-tenders. In others fire-room experience is not necessary and in many no fixed rule is in force, but the choice of oilers is left entirely to the chief engineer of the vessel. In general, a common school education, a good knowledge of the construction and operation of marine engines, and some boiler-room experience are essential and but little else. Knowledge of the operation of pumps and auxiliaries is desirable and required in many jobs. The pay is from $30 to $45 (6/5/0 to 9/7/6) a month and found in American ships, and $25 (5/4/2) per month and found in the British transatlantic service. If a young man is fairly familiar with marine engines and the engineers kindly disposed, but little experience is necessary to enable him to become a good oiler.

* Associate Professor of Naval Architecture, Massachusetts Institute of Technology, Boston, Mass.

Does Sea Ice Contain Salt?

Q.—"A" contends that after salt water ice (sea ice) has been washed with fresh water and allowed to melt, the melted water will be fresh, or in other words "A" claims that the salt is expelled from the water in the freezing. "B" claims that the salt freezes in with the water, and on melting the water will be salt. H. M. S.

A.—"A" is correct if the ice has been produced by quiet freezing, as freezing salt water excludes the salt. It is entirely possible, however, to have salt held in the ice mechanically, as when spray is blown onto a body or ice cake and freezes there. Physically it is true that ice which forms in a brine solution is composed of fresh water crystals without salt in it.

Horsepower from Indicator Cards

Q.—In computing the horsepower from indicator cards, is the horsepower of both head and crank ends added together? It would seem to me that as steam was acting on only one side of the piston at a time the horsepower of the engine would be the average of the two ends. P. MacF.

A.—The pressure on the head end acts on the down stroke and the pressure on the crank end acts on the up stroke, so that there are two impulses on the piston rod, a pull and push for each revolution of the crank; therefore, if we wish the *total* work per revolution it is the *sum* of these pressures multiplied by the distance moved through. Work done per minute ÷ 33,000 = horsepower.

Power Calculations

Q.—Will you please figure for me the indicated horsepower necessary to drive the following ship 16½ knots and the diameter and pitch of a suitable propeller for it? Unless it takes up too much of your valuable column, I should appreciate it if the calculations might be given in detail. The vessel is 425 feet between perpendiculars, 54 feet 8 inches beam and 22 feet 6 inches draft, displacement 9,389 tons, twin-screw, and the engines not to exceed 90 revolutions per minute. R. C.

A.—The power calculation is the one to make first and the effective horsepower which is used in overcoming the resistance of the hull is the frictional horsepower plus the wave-making horsepower. The first may be calculated approximately from the following formula, if the dimensions of the vessel are known:

$$\text{Frictional horsepower} = .0307\, S\, V^{2.83}$$ where { S is the wetted surface, V is the speed in knots, and a coefficient of friction of .01 is assumed.

From Taylor's formula:

$$S = 15.5 \sqrt{D \times L}$$

where D = displacement in tons.
L = length in feet.

$$S = 15.5 \sqrt{9,380 \times 425}.$$
$$S = 31,000 \text{ square feet.}$$

$$\text{Friction horsepower} = .0307 \times 31,000 \times 27.89 = 2,640.$$

The wave-making or residuary horsepower cannot be figured from any formula. The residuary resistance per ton of displacement as determined from model experiments is given in a series of curves ("Speed and Power

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of Ships," by D. W. Taylor) and for the form given this is very nearly 3 pounds; therefore, the wave-making horsepower = .00307 × 3 × 9,380 × 16.5 = 1,425 horsepower. The total effective horsepower is then the sum of the frictional and wave-making horsepowers, or 2,640 + 1,425 = 4,065. In general the ratio of effective horsepower to indicated horsepower is as 1 is to 2, so that indicated horsepower = 4,065 × 2 = 8,130. This, then, is the indicated horsepower necessary to propel the hull given at a speed of 16½ knots.

The determination of a propeller for this case in accordance with the method indicated in "Propellers," by C. H. Peabody, gives a three-bladed propeller 16 feet diameter, 22 feet pitch and 70 percent efficiency at 88 revolutions per minute. The individual steps in the propeller calculation consist of determining the value of a function containing the known properties as horsepower, speed and revolutions per minute, and from tables which have been compiled from experimental information the diameter and pitch in consonance with these is found. The actual numerical work for this case would be unintelligible without the tables and context.

Relative Advantages of Turbines, Diesel Engine and Reciprocating Steam Engine Drive

Q.—What are the relative advantages of the turbine and Diesel engines over the reciprocating engine for ship propulsion in regard to first cost, steam consumption, service, and useful life? A. T. S.

A.—The question is too broad to be properly answered here, as it involves the consideration of so many factors as to make a comprehensive answer far too voluminous. Briefly, however, conservative engineering judgment, backed by experience in actual installations, seems to warrant the following generalizations. Direct connected turbines show excellent economy and are reliable for high-speed vessels and for these installations result in a saving of weight and space for propelling machinery. They are higher in first cost than a reciprocating steam engine installation.

For vessels of 15 knots or under, the principal turbine companies now recommend geared turbines, and even for high-speed vessels this is finding much favor. Confining attention to vessels of the cargo-carrying class at speeds below 15 knots, the margin between the several methods of propulsion is so small that local or economic conditions which may have no bearing upon engineering features often are the deciding factors.

A careful comparison of two vessels of identical external characteristics, but with a reciprocating steam engine and Diesel engines for the propelling machinery recently appeared and gives an excellent account of several items in coming to a reasonable decision.* A table is appended giving this comparison and the comparison is extended in the same manner to include approximate figures for geared turbines. Allowance has been made for the difference in tonnage measurement and deadweight carrying capacity which the systems involve. The vessel chosen for the comparison is 400 feet length between perpendiculars, 52 feet beam, 29 feet 9 inches depth, 26 feet 1 inch draft. Total deadweight carrying capacity in tons, 8,640 (steam), 8,775 (Diesel), 8,805 (geared turbines). Speed, 10½ knots; radius of action, 3,500 miles; fuel consumption, 1.6 pounds per indicated horsepower per hour; 1.6 pounds per indicated horsepower per hour (reciprocating); 1.2 pounds per indicated horsepower per hour (turbine); .61 pound per indicated horsepower per hour (Diesel).

* "The Relative Possibilities of the Diesel Oil Engine, Geared Turbine and Suction Gas Engine." North East Coast Institution of Engineers and Shipbuilders, 1912.

CAPITAL INVESTED	Oil Engine		Steam Engine		Geared Turbine	
	$381,000		$308,000		$351,000	
	Per Voyage	Per Month	Per Voyage	Per Month	Per Voyage	Per Month
Insurance	.....	$2,390	.....	$1,800	.....	$2,050
Fuel (oil at $9.77, coal at $3.63)	$1,756	.....	$2,170	.....	$1,738	.....
Wages and provisions	.....	1,700	.....	2,000	.....	1,950
Wear and tear	.....	537	.....	488	.....	439
Deck and engine - room stores	.....	537	.....	488	.....	488
Port charges, at $1.22 per ton	3,680	.....	3,590	.....	3,590	.....
	$5,436	$5,164	$5,760	$4,776	$5,328	$4,927
16 voyages	87,000	.....	92,200	.....	85,300	.....
12 months	62,000	.....	57,300	.....	59,200	.....
	$149,000	.....	$149,500	.....	$144,500	.....
5% depreciation	19,000	.....	15,400	.....	17,550	.....
Management	2,440	.....	2,440	.....	2,440	.....
	$170,440	.....	$167,340	.....	$164,490	.....
Freight-earning cargo carried, tons	16 × 8,530 = 136,480		16 × 7,880 = 126,080		16 × 7,910 = 126,560	
	170,440.00 / 136,480.00 = $1.25 per ton		167,340.00 / 126,080.00 = $1.33 per ton		164,490.00 / 126,560.00 = $1.30 per ton	

In general, for moderate speed ships which would be driven by a single reciprocating engine, a Diesel engine ship is more costly, as the machinery is more expensive and the hull also, on account of the twin screws, oiltight work, etc., but the space occupied by propelling machinery is less and the weight is less, so that there is a gain in cargo-carrying capacity and weight. At the present state of development Diesel engines are not suitable for high-powered vessels from engineering rather than economic reasons.

Geared turbines undoubtedly operate on increased steam economy, but there is little difference in the machinery weight and space and the first cost is higher than the standard machinery. A gain claimed for them is the absence of racing during heavy weather, which, however, is always less noticeable in any form of twin screw drive. The item of first cost is so important that it oftentimes settles the question out of hand, as it persists in the shape of increased insurance, etc., throughout the life of the vessel, and may transform receipts from profit to loss.

There is but little to choose as to reliability between the various systems, and figures are not available as to length of useful life. It is probably questionable, however, if either Diesel engines or geared turbines will have as long a period of usefulness as the present standard steam engine of the reciprocating type.

It is interesting to note that if the price of oil for the Diesel engine rises above that indicated in the table, or the price of coal falls below the given price, the margin quoted is seriously affected and may be reversed.

LAUNCH OF ONTARIO NO. 2.—The car ferry *Ontario No. 2*, said to be the largest vessel of the kind ever built on the Great Lakes, was launched recently from the yards of the Polson Iron Works, Toronto, Ont. The dimensions of the vessel are: Length, 318 feet; beam, 34 feet; depth of hull, 20 feet 6 inches; tonnage, 5,400; horsepower, 4,500; capacity, 60 loaded railway cars and 1,000 passengers; launching weight, 2,100 tons. The vessel will have accommodations on the upper deck for 800 first class passengers, while the lower deck will be used for the railway cars and the second class passengers. The cost of the vessel is about $500,000 (£102,500), and it will run between Cobourg, Ont., and Charlotte, N. Y., the port for Rochester.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries — Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Shipbuilding in Navy Yards

The remarks published in recent numbers of INTERNATIONAL MARINE ENGINEERING, both in the editorials and in the letters from marine engineers, relating to the policy and wisdom of constructing naval vessels at navy yards, have been of great interest to me. This is a policy the soundness of which is most certainly open to question and to doubt. The doubts as to the advisability of constructing battleships and destroyers in navy yards are not in the minds of civilians alone; on the contrary, they are in the minds of a very large number of naval officers. I do not have any intention of criticising either the policy of the Navy Department in building ships at navy yards or the remarks that have appeared in your paper; nevertheless, I desire to set forth a few of the facts as they appear to me.

I think that naval officers in general concede that permanent employment must be furnished at navy yards if a highly skilled and hard-working class of workmen is to be retained. In order to furnish this permanent employment, there must always be enough work on hand to keep the workmen employed for the full eight-hour day, six days in the week (except in the summer, when Saturday afternoon is given as a holiday). Now the general character of naval repair work and overhauling is not such as to offer this steady employment; in fact, it is more or less intermittent. Even under the best of conditions and with the greatest of foresight, there will be a great deal of work on hand at one time and a complete absence of it at other times. Military considerations do not allow this work to be spread out so as to make a good general average; it must be rushed to completion as soon as possible so that the ship under repair may rejoin the fleet and become a real unit for battle, rather than a paper one. A long stay at a navy yard is nearly always accompanied by a more or less complete demoralization of the crew, in the sense of a smooth working and efficient whole, so nearly all captains are exceedingly anxious to stay at a navy yard as short a time as possible.

The question then appears to be how to find steady employment for a body of skilled workmen that will be sufficiently large to take up and rush to rapid completion such general repairs and overhauling as the active units of the fleet may need. I believe that the only answer to this is to be found in shipbuilding.

However, this shipbuilding would be of an entirely different character than that which comes in for your editorial criticism. The character of shipbuilding necessary to fulfil the conditions given above would be of a distinctly non-military type; of a character for which there should not be any immediate need, such as fuel ships, transports, supply ships, tugs, etc.—in fact, it would not include any ships of a type which one or two years' additional time of building might render almost obsolete when commissioned.

The sole object of this shipbuilding would be to carry out the same function for the navy yard force that an air chamber does for a feed pump. It would act as a reservoir to receive the workmen during slack periods at the yard and, later, would act as a supply chamber to furnish workmen when they were in demand for other work. Of course the writer fully realizes that this would make the cost of the ship very high and would make the time of construction quite long, but these are secondary considerations for the types of vessels mentioned, especially when one considers the reasons for navy yard construction.

The writer believes that each navy yard should always have one ship of the character above mentioned under construction at all times. Such a policy would very soon give enough auxiliaries to the fleet, so that there would not be any pressing need to rush to completion those ships under construction. It would seem that such a policy would be all that the navy yards could fairly ask. The policy of building battleships and destroyers at navy yards does not fill the want mentioned above, since there is just as much haste in rushing such ships to completion as would prevail at a private yard, and for this reason men cannot be spared from such construction work to take up repairs when needed.

In regard to the quality of vessels built, I may state that, with few exceptions, I do not think that there is any appreciable difference. All navy yard built ships seem to be operating effectively and economically. The greater number of privately built ships are in the same class, but there are some few exceptions which furnish shining exceptions to any one desiring to cite them as models of extremely poor ships, commonly known in the fleet as "lame ducks." It would seem that a repetition of these vessels should be prevented by an efficient inspection force, properly backed up by the department.

From what I can learn, the comparing of "bids" from private companies and "estimates" from navy yards is not at all a fair proposition. As you have stated, if a contractor runs over his bid he loses his money, whereas if a yard runs over its estimates it simply applies for and gets more. If the Department desires to build ships at a navy yard, it is entirely proper that it should get the best estimates possible of the cost of such construction, but certainly such estimates, without financial responsibility, cannot be properly compared to the bids of regularly bonded contractors.

I cannot agree with your correspondent in that it is necessary for the government to keep ships under construction at all times "so that in case of emergency the government would not be at the mercy of private contractors, who charge all they can get in order to pay dividends, or what they consider a fair profit." It seems to me that more nearly is the reverse of this true, and that just so far as the government undertakes the building of the few fighting vessels that are authorized, the private shipbuilding companies will allow their plants to become more or less obsolete for this purpose, for without a fair prospect of business it cannot pay them to keep up their special equipment for this class of work. If this equipment is allowed to deteriorate, the govern-

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ment will surely be at the mercy of private contractors in case of an emergency, because at such a time the navy yards will have all they can do to keep the battle fleet and its auxiliaries ready for action without attempting to expand their shipbuilding facilities. The private companies will then be obliged to charge what will seem to be an exorbitant price, simply because they will not be in a condition to undertake economically large naval work. It would seem that the natural competition among the large shipbuilding companies must certainly protect the government from exorbitant prices for naval work under normal conditions.

There are many ways in which the government is able to save on its cost of building which are not open to the contractor. One of these is in the manner and time of carrying out the trial trips and preliminary acceptance trials. When a vessel is built by a contractor it is required that she shall carry out certain steaming trials, shall make a certain designated speed, and shall show a certain economy of fuel and water before being delivered to the government. The carrying out of the necessary work and steaming to accomplish these results add an item of expense which is of a very appreciable magnitude. In order to make the contractors' cost comparable to the navy yard estimate these trials should all be carried out by the government for a ship built at a navy yard, and their cost should be added to the cost of the ship. That this is not always the case is shown by the fact that at least one government-built battleship has held her steaming trials after being commissioned, and that the cost of such trials has therefore been largely charged to the cost of maintenance of the navy rather than to the cost of the vessel's construction.

The writer does not say that the government should not take advantage of the saving which is accomplished by using the ship's regular complement; or that it should not get the great advantage of instructing the men of the engineer's department in steaming at full power; or that it should not have the opportunity to collect all the necessary data for handling the ship while carrying out the ship's official trials. It would seem that this is a very laudable way of "killing two birds with one stone." However, it seems that all such things should be considered when one attempts to compare a contractor's bid with a navy yard estimate, and that the fact that the estimate is somewhat lower than the bid should not be taken to mean that the contractor is charging all he thinks he can get—usually believed to be more than he ought to get.

I trust that this letter is not too long for your consideration.

A NAVAL OFFICER.

The Present Position of the Marine Distillate (Paraffin) Engine

During the past few years a great deal has been written about the development of the Diesel and semi-Diesel or hot-bulb engines, and the progress of these recent types of engines has received widespread attention. On account of the rapid-fire improvements and advances that have been made in the heavy oil engine, and also because of its application in large units, this type has rather obscured the earlier electric ignition engine in the eyes of the public.

It is largely true that the development of the gasoline (petrol) engine has been limited to comparatively small units, for the cost of operating a large unit on the lighter fuels would hardly be offset by any advantages that might be gained by the use of this type of machine. Be it said, however, that the internal combustion engine of the electric ignition type is not limited to the use of the lightest products of petroleum. In both Great Britain and America engines of this type using the heavier distillates (paraffin) have reached a high stage of development, and in America they have been successfully constructed in units of 500, or even 600 horsepower. England, though she leads America in the Diesel and hot-bulb engines, has not kept pace with her brother across the water in the development of the heavy paraffin engine. The greatest progress in this type of machine has without question been made on the Pacific Coast, where conditions, both as regards available fuel supply and field of application, have been especially advantageous.

The manufacture of light, high-speed gasoline (petrol) engines, for racing and pleasure boats, seems to have been carried on exclusively in the Eastern States of America,

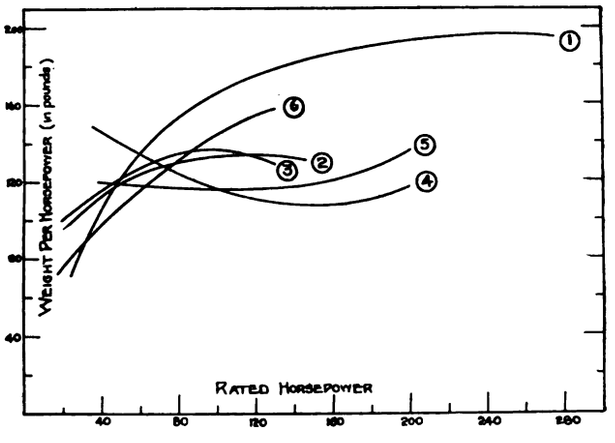

Fig. 1

while the construction of the slow-speed, heavy motor for large commercial vessels is, with a few exceptions, confined to the western coast. The reason for this is not hard to find. California is well known as one of the greatest oil-producing districts in the world, and there has consequently been an enormous supply of refined and semi-refined products available for consumption. It is only natural, then, that a simple and reliable type of engine should be developed for the utilization of these fuels.

With the construction of the first successful marine engine in San Francisco in 1884, it was recognized that the most efficient and reliable results for commercial purposes were to be obtained by heavy construction and slow rotational speeds. The service demanded by a work boat, of its propelling machinery, required an engine that would give constant service day in and day out under all conditions. A type of engine was consequently developed that closely resembles the commercial Diesel motors of the present day, as regards speed and heavy structural details.

At the present time there are half a dozen manufacturers of these heavy four-cycle distillate engines on the Pacific Coast, and from an analysis of each make of engine, it will be found that the variations in weight, speed, cylinder dimensions and general design are slight. In the following discussion three and four cylinder engines will only be considered as, of course, the one and two cylinder engines are built only in the smaller sizes.

WEIGHT AND SPEED

At first sight these heavy duty engines may appear to be cumbersome, but it must be remembered, as stated above, that they are designed primarily for commercial service, where the requirements often call for full load

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output day and night without a stop. Fig. 1 shows the result of plotting weights per horsepower against horsepower ratings, indicating the variation of the former quantity as the size of the engine increases. The weights given are the net weights of engines, including reverse gears. In some of the lighter types of high-speed engines the reverse gears are separate, but in the type under consideration the gear pot is mounted on an extension cast on the main engine bed, thus providing an extremely rigid unit, not unlike the modern automobile plant.

The normal epeeds of these engines are found to be comparatively low, especially in the larger sizes, thus enabling higher propeller efficiencies to be obtained and at the same time reducing the wear and tear incident to high speeds. Piston speeds vary from 550 to 650 feet per minute, while rotational speeds range from 200 to 500 revolutions per minute, depending on the size of the engine. Fig. 2 shows the variation of these quantities with respect to horsepower ratings, the curve shown representing the average of the different makes, which vary but slightly in this particular. The following average figures will perhaps give a little clearer idea of the weights and speeds of a few selected sizes, including single and double cylinder engines.

Horsepower.	No. Cylinders.	Revolutions Per Minute.	Weight, Pounds.	Weight Per Horsepower, Pounds.
5	1	400	750	150
30	2	300	4,200	140
80	3	300	9,600	120
250	4	225	50,000	200
500	8	200	90,000	180

From the above it will be seen that the units of 250 horsepower and over are exceedingly heavy machines and are only fitted for vessels of the heaviest construction. Only one manufacturer has undertaken the regular con-

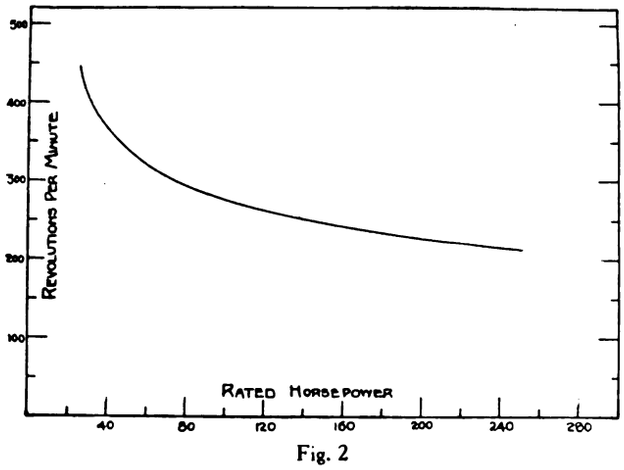

Fig. 2

struction of these heavy engines in sizes larger than 150 or 200 horsepower, but a considerable number of large installations have been made by the one concern. During the past few years fifteen installations, aggregating 4,467 horsepower, have been put into successful operation. This average of 300 horsepower per vessel is probably not exceeded by an equal number of the largest vessels propelled by hot-bulb engines.

PRICE

The purchaser of an engine is perhaps interested more in price than in any other item, and the curves shown in Fig. 3 should consequently prove of interest. The prices include engine, propeller, shafting, magneto, air pump, and, in fact, all that is essential for a complete installation. Discounts sufficient to approximately cover the cost of installing the engine in a boat are ordinarily given when an engine is shipped, so that the prices as given may be taken to be the cost of an installation ready to run.

The subject of price seems to be in an extremely unsettled condition and widely variant prices are often quoted on engines of apparently equal merit. However, it is most probable that the variation in price is due in part to power ratings and to features of design and construction that are incorporated in order to produce slightly

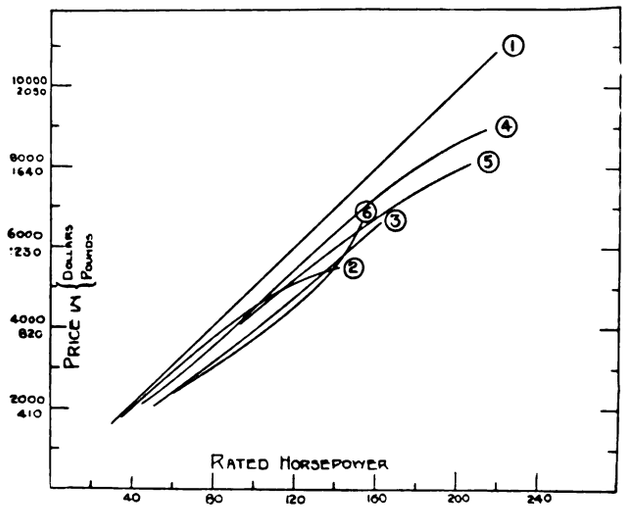

Fig. 3

more efficient results. It is nearly always a safe assumption that the more expensive machine has had more care expended in its design and construction, especially in this day of keen competition.

In conclusion it may be said that the internal combustion engine of the electric ignition type has advanced to a point where practically as much faith is placed in its continuous operation as in that of the steam engine. Units as large as 600 horsepower have been successfully constructed, and large commercial vessels equipped with engines of this type have been put into commission on long runs into the open sea under conditions where the safety of the vessel is often dependent on the uninterrupted operation of the propelling machinery. A number of specific instances might be cited of power vessels that have logged upwards of 200,000 or even 300,000 miles and that are still in daily operation.

San Francisco, Cal. CHARLES J. BELDEN.

Gas Engine Needle Valve Settings

In the operation of gas engines the effect of varying the needle valve settings upon the fuel consumption of the engine is desirable knowledge. For the information of those interested, results of a test run on an International Harvester engine, 6 inches by 10 inches, 300-350 revolutions per minute, for both alcohol and gasolene (petrol), are published.

The brake horsepower of the engine tested was maintained as nearly constant as possible in order to determine comparative results and to eliminate that variable. The radius of the brake arm was 1.7 feet, the pull maintained constant 11 pounds, and the engine constant $k = .003255$ and the brake horsepower $= .003255 \times$ revolutions per minute $\times$ pull. The specific gravity of the alcohol used was .93, and that of the gasolene (petrol) .72. The opening of the needle valve was increased from a minimum to a maximum and gave the results tabulated.

From the tables and the curves of Fig. 1 the cost of

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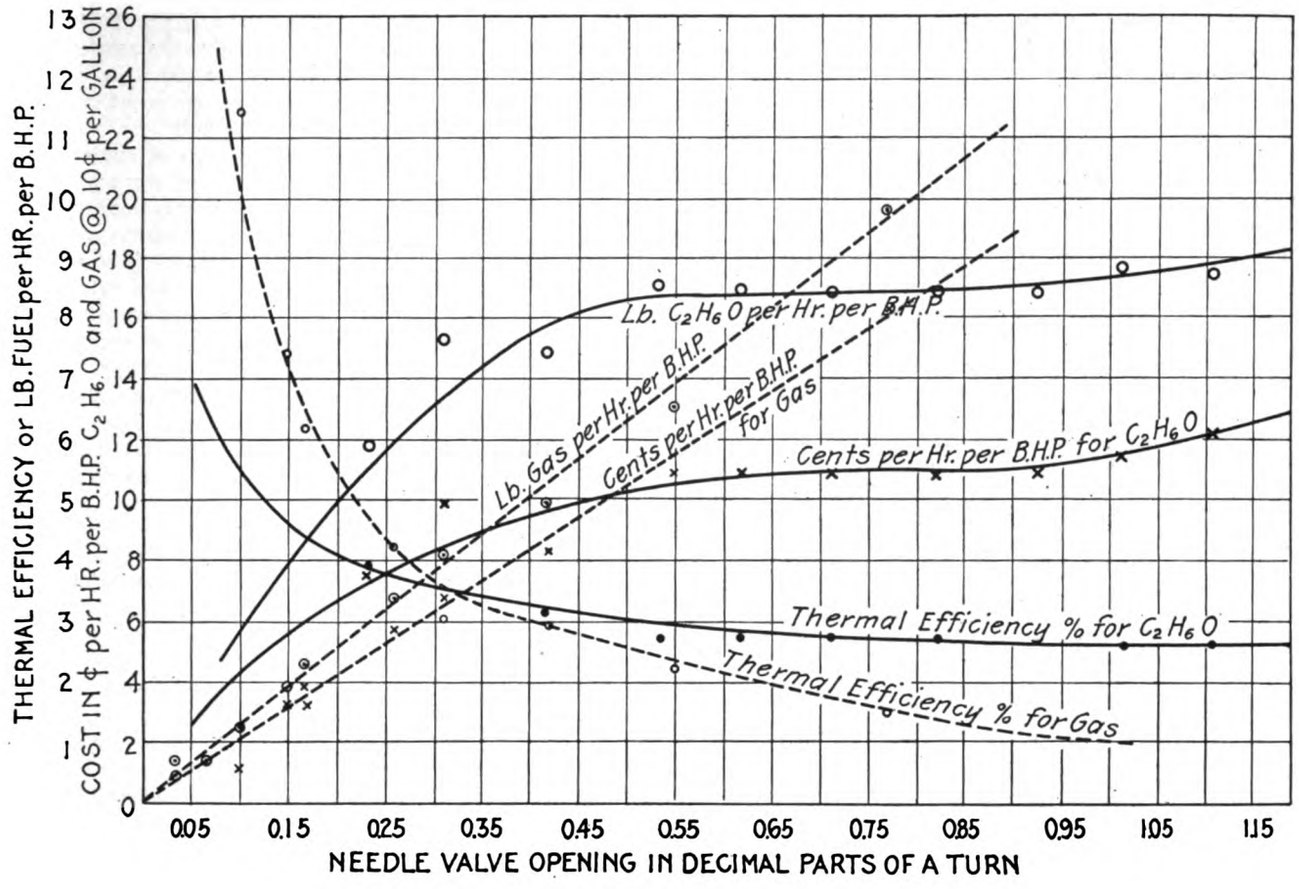
THERMAL EFFICIENCY or LB. FUEL per HR. per B.H.P.
COST IN ¢ per HR. per B.H.P. C_2H_6O and GAS @ 10¢ per GALLON
NEEDLE VALVE OPENING IN DECIMAL PARTS OF A TURN
Lb. C_2H_6O per Hr. per B.H.P.
Lb. Gas per Hr. per B.H.P.
Cents per Hr. per B.H.P. for Gas
Cents per Hr. per B.H.P. for C_2H_6O
Thermal Efficiency % for C_2H_6O
Thermal Efficiency % for Gas

Fig. 1

TABLE A—ALCOHOL (DENATURED)

R. P. M.	Needle Valve Opening	Net Pull, Lbs.	B. H. P.	Pounds Alcohol Per Hour	Pounds Alcohol Per Hour per B. H. P.	Gallons Per Hour Per B. H. P.	Ther. Eff., Per-cent	Cost Per Hr. Per B. H. P. at 40 Cents	Cost Per Hr. per B. H. P. at 10 Cents.
328	.23	11	1.173	6.90	5.90	.76	3.92	30.4	7.6
333	.33	11	1.190	9.12	7.67	.99	3.03	39.6	9.9
338	.43	11	1.210	9.00	7.44	.96	3.13	38.4	9.6
333	.53	11	1.195	10.93	8.55	1.103	2.70	44.1	11.03
336	.63	11	1.210	10.22	8.46	1.092	2.75	43.7	10.92
338	.73	11	1.210	10.22	8.46	1.092	2.75	43.7	10.92
338	.83	11	1.210	10.22	8.46	1.092	2.75	43.7	10.92
336	.93	11	1.210	10.22	8.46	1.092	2.75	43.7	10.92
338	1.03	11	1.210	10.70	8.86	1.145	2.60	45.8	11.45
330	1.13	11	1.180	10.30	8.72	1.125	2.66	45.0	11.25
332	2.50	11	1.190	11.23	9.45	1.220	2.46	48.8	12.20
330	4.00	11	1.180	15.00	12.70	1.640	1.83	65.6	16.40

The calorific value of this alcohol was 11000.

Therefore, the thermal efficiency $= \frac{2545}{\text{Pounds fuel per h. per B. H. P.} \times 11000}$

TABLE B.—GASOLENE (PETROL), CALORIFIC POWER = 18000

R. P. M.	Needle Valve Opening	Net Pull, Lbs.	B. H. P.	Pounds Gas. Per Hour	Pounds Gas. Per Hr. Per B.H.P.	Gallons Per Hr. Per B. H. P.	Ther. Eff., Per-cent	Cost Per Hr. Per B. H. P. at 10 Cents
328	.03	11	1.173	.811	.693	.1155	20.5	1.155
333	.07	11	1.190	.824	.698	.1162	20.3	1.163
338	.11	11	1.210	1.470	1.245	.2075	11.4	2.075
333	.15	11	1.195	2.280	1.950	.3250	7.4	3.250
336	.18	11	1.210	2.730	2.300	.3833	6.15	3.833
338	.26	11	1.210	4.090	3.380	.5640	4.2	5.640
338	.33	11	1.210	4.920	4.070	.6780	3.5	6.780
336	.44	11	1.210	5.990	4.950	.8250	2.9	8.250
338	.54	11	1.210	7.920	6.545	1.0900	2.2	10.900
330	.77	11	1.180	11.950	9.800	1.6330	1.5	16.330

Thermal efficiency $= \frac{2545}{\text{Pounds fuel per hr. per B. H. P.} \times 18000}$

operation for a constant load increases rapidly for increased needle valve opening in the case of gasolene (petrol), while for alcohol it reaches its first maximum at about one-half turn and remains nearly constant until the valve is opened a full turn, after which it mounts rapidly. If denatured alcohol could be purchased for the same amount per gallon as gasolene (petrol), these curves show that it would be the cheaper fuel for loads requiring the needle valve to be opened one-half turn or more, for from that point on the consumption of alcohol per hour per brake horsepower is less than that for gasolene (petrol). Therefore it naturally follows that from the one-half turn point on, the thermal efficiency of the gas engine using alcohol is higher than when using gasolene (petrol). As, however, the cost per gallon of denatured alcohol is greatly in excess of that of gasolene (petrol), the net cost per hour per brake horsepower is lower for the gasolene (petrol). In order to compare their relative merits regardless of cost, the curves have been plotted on an equal cost of 10 cents (5d.) per gallon.

New York. BRUCE R. WARE.

An Interesting Bit of History

The drawing which accompanies this letter is one which, I think, will interest most readers of INTERNATIONAL MARINE ENGINEERING. Probably the two most interesting vessels of fifty years ago were the Stevens *Battery* and the *Monitor*. The Stevens *Battery* was way

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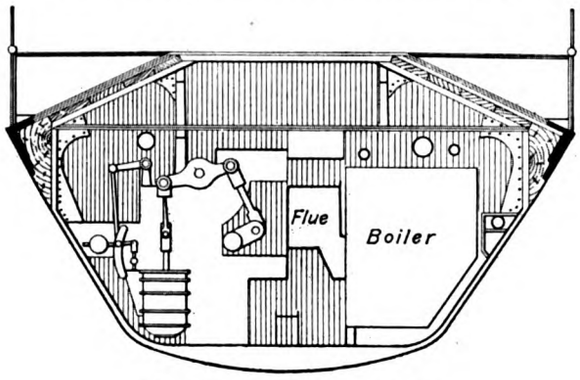
ahead of its time, and the drawing here shown is proof of it, as the idea of twin screws and multi-cylinder engines with short strokes and high speed is certainly modern practice.

The drawing came into my possession in the following way: The late Mr. Myers Coryel came into my office about a year before he died. He took from his pocket a tracing of the drawing here shown and told me the drawing was made by him about 1851 for E. A. Stevens, the founder of Stevens Institute. He said that the study was made and discussed by Mr. Stevens with men who were later connected with the Quintard Iron Works and the Delamater Iron Works.

Mr. Coryel was, of course, a very young man at that time, but he remembered very clearly the points under discussion, which were the necessity of keeping the engines below the waterline and the protective deck. The short connections were looked at askance and the short stroke with horror by all save Mr. Stevens, who insisted that greater economy would result on account of the higher revolutions which would allow smaller propeller



Cross-Section of Stevens Battery

wheels, which, he also insisted, would make for economy. Mr. Coryel was not sure whether it was intended to use eight cylinders on each shaft or four, but he was inclined to think it was the former. He also said that Mr. Stevens suggested that it might be possible to effect a greater economy by exhausting from the cylinders of one engine into the cylinders of the second engine, making them somewhat larger in bore. This was not favorably looked upon by the others, however.

Mr. Stevens wanted to use a boiler pressure of not less than 100 pounds, and this was pronounced impossible, unless a different type of boiler should be designed by Mr. Stevens, and this, he said, he could do by using copper tubes of small diameter and having the water inside them and the fire outside. By small tubes, Mr. Coryel said, that tubes of 2 inches to 2½ inches were meant. As far as he could remember, however, Mr. Stevens never made any working drawing for this class of boiler.

The drawing clearly shows the boiler, engine and crankshaft. Mr. Stevens gave a great deal of attention to the valve movement, and the one finally settled on for this engine was a cam shaft driven from the main shaft by means of a chain and sprocket wheels. The chain, however, was not exactly a chain but a wire cable made of copper on which were fastened balls which fitted into semi-circular depressions in the sprocket wheels.

Experiments were made with this drive, but it was found difficult to hold the balls in position. This trouble was overcome, however, by making one of the balls of composition and braising it in place and by holding the other balls in position by stringing short pieces of tubes between them and cutting out the sprocket wheels for the tubing. It is rather strange that a number of years ago experiments were made with this very same drive in Europe on Corliss engines to connect up the governor. These engines, as far as I know, were never built.

Mr. Isaac Newton undertook the design of engines for the Stevens *Battery* about 1869, and they were built by the Delamater Iron Works. The engines were built rights and lefts for the twin shafts. The cylinders were 72 inches in diameter with a 45-inch stroke. The cut-off valve was driven separately from the main valve and placed at the side of the valve chest so that the main valve could be removed without disturbing the cut-off valve.

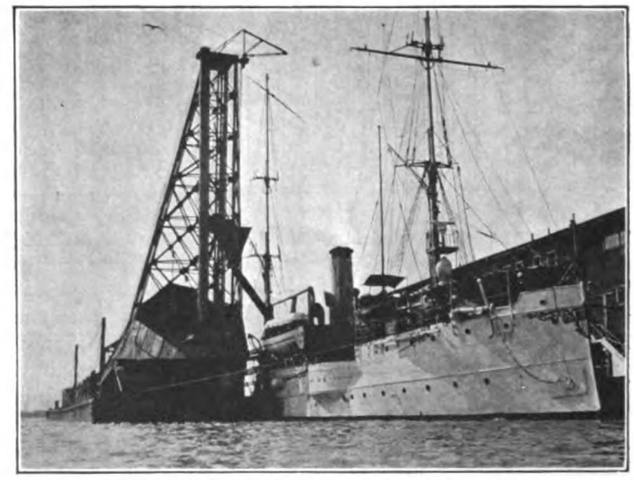
The main valve was balanced for pressure and was also fitted with an air-balancing cylinder device. Perhaps some of the readers of this journal can tell what became of these engines when the *Battery* was broken up before completion.

General George B. McClellan was given the job to complete the *Battery* and he spent a million dollars, more or less, getting ready to do the work. Mr. Stevens had left the *Battery* and a million dollars to the State of New Jersey for its completion, but as the State could not have a navy, New Jersey gave them back to the estate of E. A. Stevens and his heirs, whereupon everybody who had any possible connection with that talented family put in claims for a part of that million and the *Battery,* so the matter got into the law and it took about eleven years, I think, for the courts to arrive at the remarkable conclusion that as the State could not own a navy it could not accept Mr. Stevens' gift; therefore, as it had never owned the million dollars and the Stevens *Battery*, it could not possibly give it back to E. A. Stevens and his heirs. It is pretty safe to say that this decision would have been rendered more promptly if the Stevens Estate had not been so large.

New London, Conn. W. D. FORBES.

Elevator Coal Barge at Mobile

The illustration shows the United States gunboat *Petrel* being coaled by the Pratt Consolidated Coal Com-



Elevator Barge *Blossburg* Coaling U. S. S. *Petrel*

pany's elevator coal barge *Blossburg* at pier No. 1 of the Mobile & Ohio Railroad Company at Mobile. The loading capacity of this barge is 150 tons per hour, the cargo capacity of 600 tons. L. E. G.

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Marine Articles in the Engineering Press

Recent Investigations in Model Experiments—A New Method for Laying-Off Shell Plates—Future of Diesel Ships

Systematic Trials of Ship Models.—An account is given of the methods used at the model tank in Spezia for determining the best proportions of large, fast merchant vessels. A standard length is used, combined with different breadths varied in standard proportions. The four models tested were towed each at different drafts and displacements, thus gaining a full range of the resistance curves, from which the desirable unit can be selected. 18 diagrams. 1 table. 650 words.—*Schiffbau,* January 13.

The Ships of the United States Navy.—By Robert W. Neeser. A historical record of the ships of the United States Navy now in service and of their predecessors of the same name from 1776 to 1915. This article takes up the *Idaho, California* and *Mississippi,* giving a brief description of the vessels now under construction, which will be christened with these names and the main historical events regarding the services rendered by their predecessors. 4 illustrations. 7,500 words.—*United States Naval Institute Proceedings,* March-April.

Application, Improvement and Preservation of Wood in Shipbuilding.—The article enumerates the different classes of wood and their application to shipbuilding for keel-blocks, cradles, ways, molds, staging and fenders, besides for the actual construction of wood ships. Mention is made of the short life of wood material and the means of improving and preserving it. Efficient ventilation and a good covering surface of paint or oil on thoroughly dried wood are recommended as the usual means, but special value is given to the pneumatic or pressure creosote-impregnation as the best means to extend the usefulness even of inferior woods. Pronounced economy in building cost is expected from using treated beech and fir for vessels in river, harbor and coast service. Mention is made of the comparative cost and the life of creosoted barges of yellow pine for the U. S. Engineers, built in 1900. 3 tables. 4,900 words.—*Schiffbau,* March 10.

Power-Steering Gear.—By F. Leigh Martineau. A brief historical account of the development of power-steering gear brings out the fact that the gear patented in 1866 by Macfarlane Gray is generally regarded as the father of the modern steam-steering gear, as this patent covered the separate control valve and hunting gear arranged identically as fitted in all modern gears. To A. B. Brown is accorded the premier place in the development of the steering gear, who, between the years 1867 and 1905, took out no less than twenty-six patents relating to steering gears. More than half of these patents related to hydraulic-steering gear, and a large proportion to the telemotor control. At the present time all hydraulic telemotor controls used are based on the synchronizing device covered by Mr. Brown's patent, issued in 1888. The first record of a proposal to adopt electric energy for steering vessels appeared in 1893. In recent years, however, the application of electrical gears for steering vessels has advanced in a remarkable way. The author points out that a steering gear is required (1) to move the rudder to any position with as little delay as possible; (2) to hold the rudder in this position under the stresses imposed in maneuvering the ship; (3) to give way before any abnormal stress, such as caused by a wave, and automatically to return to its former position; (4) to be absolutely reliable and (5), to be economical. Taking up each of these requirements in turn, it is pointed out that savings of as much as 6 percent of the running distance of a boat per annum can be gained by the use of the most sensitive steering gear. The conclusions are drawn by the author that the electric-hydraulic steering gear is more precise and, consequently, there is a gain in the total ship's expense due to the shorter distance traveled during the year. Further gains are made by this gear on account of reliability, as there are no parts to adjust, and the gear requires less attention than steam-steering gear. A third gain which can be made with the electric hydraulic gear is the smaller steam consumption. 5 illustrations. 4,700 words.—*Transactions of the Institute of Marine Engineers,* March.

Apparatus for Marking Shellplates.—The article describes a framelike structure for furnishing a reproduction of strake edges, seam and frame rivet centers, butts and openings of outside shellplates in such manner that the plates can be accurately marked, machined and made ready for assembly even before the frames are up. It is described as a floor on girders or channel foundation with uprights of channel section and cross connections, making 8 or 10 complete transverse square frames spaced a distance equal to the frames in the ship. Movable counterbalanced channels slide up and down, one on each frame, following by their inclinations and positions the curvature of the bottom of the ship. By short templates all strake-edges, rivet holes, etc., are transferred to these cross-channels and from them to the plate. A modification for variable frame spacing is also given. The cost of this apparatus is given approximately as $1,000 (£205). 7 illustrations. 2,400 words.—*Schiffbau,* February 15.

Twin-Screw Steamships Ciudad de Buenos Aires and Ciudad de Monte Video.—Before describing in detail the two steamers *Ciudad de Buenos Aires* and *Ciudad de Monte Video,* just completed by Messrs. Cammell, Laird & Company, Ltd., Birkenhead, for service between Buenos Aires and Monte Video, attention is directed to the remarkable progress which has been made in the design of channel steamers, of which these vessels are a type. In some respects there has been greater progress in the dsign of channel steamers than in any other branch of naval architecture. The limitations imposed in the matter of length of hull and in draft, owing to harbor dimensions, have resulted in a thorough investigation by tank experiments of the problem of resistance, so that a form of hull with special reference to the lengthening of the load line without increasing the overall dimensions of the ship has yielded favorable results. In regard to machinery also, satisfactory conditions have been worked out both in the reduction of weight per unit of power and in efficiency. In no class of ship has the advance been so rapid, from paddle-wheel engines to high-speed reciprocating machinery, later to turbines directly driving triple screws, and now to turbines actuating twin screws through gearing. It is pointed out, however, that designers have failed to make equal progress in the arrangement of quarters in such vessels, the typical channel steamers hardly offering the

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most convenient arrangements for the accommodation of passengers. These new vessels, for South American owners, have a draft of only 10 feet, while the total height from the keel to the awning deck is 23 feet 3 inches, and the beam 44 feet. The length overall is 364 feet and between perpendiculars 350 feet. The G.M. is 4 feet. On the official measured mile trial the speed was 19 knots, the engines developed 5,800 shaft horsepower. The engines are of the Parsons turbine type, there being two sets of turbines each operating a propeller shaft through a gear wheel. The high-pressure turbines, which are placed inboard, made on trial a mean of 2,320 revolutions per minute, while the low-pressure turbines placed in the wings made a mean of 1,630 revolutions per minute, the propellers running at 267 revolutions per minute. The steam consumption for all purposes was about 14 pounds per shaft horsepower per hour. The thrust bearings are of the Michell type. Steam is supplied by four single-ended boilers at a pressure of 170 pounds per square inch. Either oil or coal fuel may be used. A detailed description is given of the structural arrangements, the passenger accommodations and machinery equipment. 29 illustrations. 3,300 words.—*Engineering,* December 25.

Contribution to the Question of Unsinkable Modern Ships.—The author points out that two factors should be taken into consideration for the watertight subdivision of ships: the vertical sinking after a leak and the transverse heeling or capsizing. The first has recently been considered in numerous regulations of proper bodies, the latter has not yet been touched. It was found that under certain conditions the initial stability may remain the same or increase even though certain damaged compartments are open to the sea. The factors for preserving stability of the damaged ship are discussed, to which the author adds the case of an increased or critical draft, above which stability increases. To gain a clear insight into the question the author calculated a number of examples, reduced to prismatic shape and further exemplified by models made of electrolytical copper and fitted with heeling indicator, C G adjusters and compartment flooding plugs. Thus the author feels that he is in a position to investigate the question, taking into consideration all factors, and with sufficient accuracy, so that the model experiments may serve for the building of full-sized ships. 18 diagrams. 1 table. 1 illustration. 4,400 words.—*Schiffbau,* October 28 and November 11.

The New Fruit-Carrying and Passenger Steamer Van Stirum.—Built to the order of the Atlantic Fruit Company for their new service between Central American and European ports, the steamship *Van Stirum* is the first passenger vessel turned out by the North of Ireland Shipbuilding Company, Ltd., since their Londonderry yard was put into operation a little more than two years ago. The vessel is 343 feet long overall, 45 feet beam, 20 feet ½ inch depth, molded to upper deck. The hull is subdivided by five transverse watertight bulkheads, all extending to the awning deck, and there are three complete steel decks which divide the cargo holds into compartments of suitable height for the storage of bananas, which will form the principal cargo in this service. Accommodations are provided for thirty first class passengers. A large refrigerating machine of the CO_2 duplex type, supplied by the Haslam Foundry & Engineering Company, Ltd., of Derby, is installed, which is capable of maintaining a temperature of from 50 to 55 degrees in tropical climates. Four "Sirocco" fans, direct coupled to electric motors, circulate the air through the refrigerating coolers. The air is then delivered along air trunks situated on one side of the holds and 'tween decks, from which it is distributed through the fruit compartments by means of a large series of adjustable louvres and is then drawn back to the fans through trunks on the opposite side of the vessel to repeat the same cycle of operations. The fruit spaces throughout the ship are insulated with granulated cork. The equipment of auxiliary machinery and navigating appliances is very complete. Propulsion is by a set of single-screw triple-expansion engines, with cylinders 23, 38, and 63 inches diameter by 39 inches stroke, supplied with steam by three Scotch boilers, each 15 feet 3 inches diameter by 11 feet 6 inches long, constructed for a working pressure of 180 pounds per square inch. The main engines were designed to develop about 2,400 indicated horsepower on service to give the vessel a speed of 12¾ knots; on trial, however, a speed of 14 knots was attained on the measured mile. 12 illustrations. 2,500 words.—*The Shipbuilder,* April.

Efficiency and Future of Large Diesel Ships.—The author directs attention to the fact that in comparisons between steamers and Diesel ships other factors besides thermodynamic efficiency enter. He shows that fuel oil has advanced in price within three to five years to almost three times its former figure in many harbors of Western Europe. He gives the principal other sources of special fuel oil and their characteristics. The steamer *Saltburn* and Diesel ship *Eavestone,* of equal dimensions, are technically compared, also the *Christian X* and steamer *Uckermark* commercially, the table showing the motorship the better, taking into account fuel, wages, lubrication and depreciation, but not repairs or extras. It is mentioned that often motor repairs may be sudden and severe, cylinders and covers and their parts being most affected. The advisability of using or saving some of the waste heat of the fuel is discussed. The characteristics of pneumatic, electric and steam auxiliaries are noted, and their desirability for ship work, independently driven or direct-connected to main engine. The small gain in cargo space of some of the motor ships is mentioned, also the great possibility of improvement in this direction is acknowledged. The conclusion is reached that 4- or 2-cycle engines can now be obtained of high reliability and fine efficiency, and if only fuel prices will remain within reason Diesel ships are considered to remain an important factor in oversea transportation. 4 tables. 6,100 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* January 30.

Modern Gantry Cranes.—It is stated that the blast furnaces of Middle Europe have to keep very large quantities of ore and material on hand, necessitating either frequent shifts of the very large gantry over wide fields or a special distributing crane. A description of a special gantry is given, where a possible movement of 30 degrees of one leg gives an effectively increased range at small operating cost and little complication. The length of girder is 391 feet 4 inches; the capacity 10 tons. A description is also given of a crane for docks in Vienna, Austria, where barges lie a little ways off the sloping bank with two rows of sheds further up the bank. A crane was built which can unload into the sheds through roof hatches from scows or cars. The essential feature of this crane is stated to be a triangular girder, straddled by the traveling winch and thereby gaining great stability. The crane shows 130 feet between supports, is 200 feet long and 53 feet high. Full details are given of the winch, its support, the electrical equipment with brakes, the gear and contact trolleys. 40 illustrations. 5,600 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* February 20 and March 6.

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New Books for the Marine Engineer's Library

The Theory of Heat Engines—Stability of Floating Bodies—Harbor and Shipping Problems

THE THEORY OF HEAT ENGINES. By William Inchley. Size, 5½ by 8¾ inches. Pages, 492. Illustrations, 246. London, 1913: Longmans, Green & Co. Price, 7/6 net.

Although many excellent books exist which deal solely with one or two special branches of the subject of heat engines, there are very few which deal with the subject of the theory of heat engines as a whole. In this book the author has made an attempt to give in a complete and concise form the thermodynamical and mechanical principles of the subject, and for this reason all purely descriptive matter of actual engine designs is omitted. The book is essentially one for students, and many numerical examples are carefully worked out in the text. Examples are also given at the ends of each chapter, which the student can solve for himself.

GOOD AND BAD TRADE. By R. G. Hawtrey. Size, 5¼ by 8 inches. Pages, 279. London, 1913. Constable & Co., Ltd. Price, 6s. net.

The aim of the author in preparing this book was to examine certain elements in the modern economical organization in the world which appeared to be intimately connected with fluctuations of trade. His argument was to prove that the fluctuations are due to disturbances in the available stock of money, the term money being taken to cover every species of purchasing power available for immediate use. Briefly, the essential steps of his argument may be quoted as follows: A depression of trade occurs when the amount of credit money in existence is more than the bankers think prudent having regard to their holdings of cash and they raise the rate of interest in order to reduce the excess. An expansion of trade occurs when the amount of credit money in existence is less than the bankers think prudent having regard to their holdings of cash, and they lower the rate of interest in order to encourage borrowing. Trade depressions tend to be followed by trade expansions, and trade expansions in turn to trade depressions. If at any time trade happened to be steady, any casual disturbance tends to be magnified.

STABILITY AND EQUILIBRIUM OF FLOATING BODIES. By Bernard C. Laws. Size, 5½ by 8½ inches. Pages, 351. Illustrations, 130. New York, 1914: D. Van Nostrand Company. Price, $3.50 net.

Owing to the prominence attained by the submarine and air ship in recent years, the author has considered it advisable to set forth briefly the principles underlying the stability and equilibrium of bodies floating partially or wholly submerged in water and air, supplementing the matter which has hitherto been published on the stability of ship forms. To accomplish his purpose the author found it necessary to approach the subject in a more liberal manner, treating the bodies as subject to active as well as passive forces, and to call into requisition the principles of fluid pressure, whether liquid or gaseous, in their action upon bodies at rest and in motion. An introductory chapter gives the essential points bearing on this phase of the subject, and this is followed by a discussion of general conditions, including definitions and formulæ. Then, in turn, the subjects of ships, submarines, floating docks, air craft and caissons are taken up. Owing to the scarcity of published information regarding the stability of floating docks, the book will be of special value to shipbuilders on account of this chapter alone. The data which the author gives have been derived from a long period of intimate association with the scientific side of shipbuilding and, of course, are thoroughly reliable.

THE PROBLEM OF GREATER NEW YORK AND ITS SOLUTION. By Harry Chase Brearley. Size, 6 by 9 inches. Pages, 132. Numerous illustrations. New York, 1914: The Searchlight Book Corporation. (Under the auspices of the Committee on Industrial Advancement of the Brooklyn League.)

The problem of Greater New York discussed is the harbor problem, and it is stated that Greater New York's present welfare is dangerously threatened by its harbor limitations. In considering this problem, the author points out not only the danger of New York's commercial supremacy, but also the uneconomical effects of congestion upon living conditions. The solution of the problem is held to lie in the development of a great auxiliary harbor with an ideal industrial city adjoining it at Jamaica Bay, where some improvements have already been made, and where immense possibilities await further developments of this kind. The book is an earnest plea for the future industrial prosperity of the city that is now the greatest port in the world.

COAST EROSION AND PROTECTION. By Ernest R. Matthews. Size, 6 by 8¾ inches. Pages, 147. Plates, 33. Illustrations, 74. London, 1913: Charles Griffin & Co., Ltd. Philadelphia, 1913: J. B. Lippincott Company.

Maritime engineering is a term which has frequently been applied to an important branch of civil engineering. Its application is due to the fact that the work includes harbor engineering and coast protection. This volume, which can be classed as a contribution to maritime engineering, gives a résumé of the erosion and accretion that are taking place around the coasts of Great Britain and Ireland. It treats comprehensively of all forms of sea defenses, the merits and demerits of each type being fully discussed. Special consideration is given to methods of construction in reinforced concrete, and, what is of especial value, comparisons of costs are stated. The action of sea water on concrete is of such importance that the author has carried out numerous experiments with a view to preventing as far as possible the destruction of concrete taking place from this cause. The results which he gives in this book from these experiments will be found very useful for practical application.

SHIPS AND SHIPPING OF OLD NEW YORK is the title of a booklet that has been printed for the Bank of the Manhattan Company, 40 Wall street, New York. It contains a brief account of the interesting phases of the commerce of New York from the foundation of the city to the beginning of the Civil War. It contains a large number of reproductions of interesting and rare old pictures, together with much information regarding the days when the American merchant marine in trade all over the world was a reality. Anyone interested in the history of the American merchant marine, especially with reference to the port of New York, will find a copy of this book very readable.

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ENGINEERING SPECIALTIES

The Morris Patent Double Speed Bottom-Block

For speeding up the lifting of loads on cranes and other lifting gear, Herbert Morris, Ltd., Loughborough, Leicestershire, has placed on the market a two-speed bottom chain block which provides a fast speed for the quicker handling of loads up to half the capacity of the gear, while

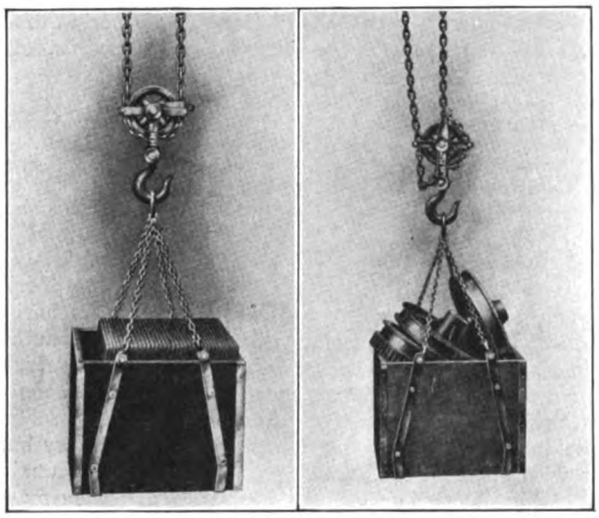


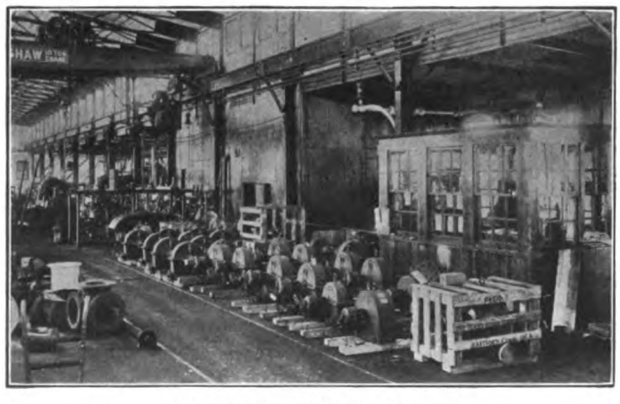
Fig. 1.—Lifting Heavy Load at Normal Speed

Fig. 2.—Lifting Light Load at Double Speed

heavier loads are lifted in the usual manner. From the illustrations it will be seen that the block is made with an attachment for linking on to the live side of the chain, which then takes the load up at double the normal speed. In ordinary practice it is found that most loads are under half the capacity of the gear. The block can be adapted to practically any make of crane or traveling gear lifting on a double chain.

Large Shipment of Terry Turbines

An order for twenty-three 60-horsepower Terry turbines for driving forced draft blowers in the new Christian street station of the Philadelphia Electric Company

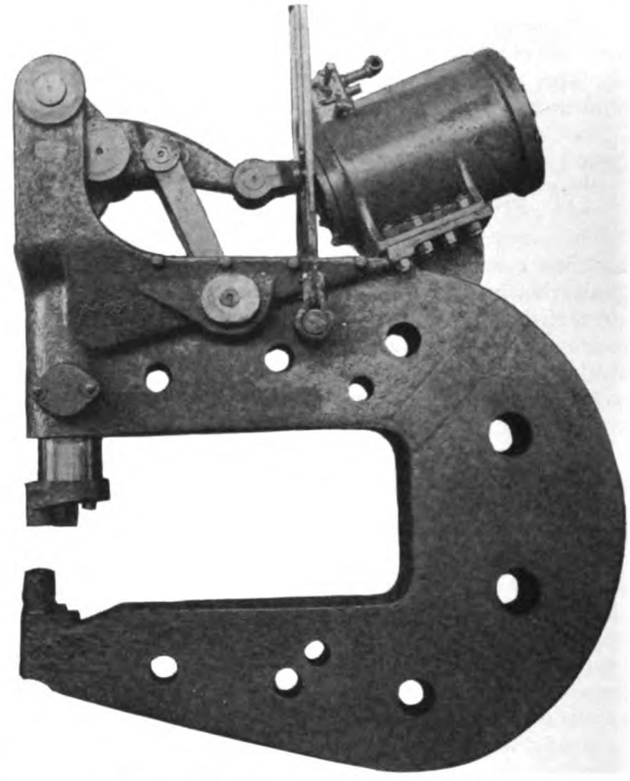


View in Terry Turbine Shops

has recently been filled by the Terry Steam Turbine Company, Hartford, Conn. Twenty of these turbines crated ready for shipment are shown in the illustration. In the background of the photograph may be seen the testing department at the Terry shops, where four vertical turbines of the type built for forced draft work on torpedo boat destroyers can be seen undergoing tests. A 100-kilowatt composite-design direct generator set can also be seen on the platform in the rear of the testing department. Power for driving the machinery in the shops of the Terry Turbine Company is derived from a 50-kilowatt turbo generator and a 20-kilowatt turbo generator located just back of the superintendent's office shown in the photograph.

One Hundred-Ton Hanna Type Pneumatic Riveter

A 100-ton, 48-inch reach, 24-inch gap pneumatic riveter, manufactured by the Hanna Engineering Works, has recently been placed on the market by the Vulcan Engineering Sales Company, Chicago, Ill. This heavy duty riveter is furnished with a cylinder having a 22-inch piston stroke with a relative travel of 6 inches of the rivet die. During



Hanna 48-Inch Reach, 24-Inch Gap Riveter

the first half of the piston travel, that is, 11 inches, which represents approximately the first 5 inches of die travel, the movement takes place through toggle action. At this point the mechanism automatically changes into a simple lever action, so that for every inch of the last 11 inches of piston travel the rivet die will move forward one-eleventh of an inch, or a total of one inch, thus producing the rated tonnage of the machine at the rivet die practically uniform for the last inch of die travel.

On account of the considerable distance through which the rated pressure is exerted, careful adjustment of the die screw is unnecessary, consequently there is no necessity for striking a rivet more than once. With each stroke of the machine, the rivet is set with a predetermined tonnage which is produced irrespective of the judgment of the operator and leaves no uncertainty as to whether or not sufficient pressure has been given to the rivet.

Owing to the fact of the slow movement of the die during the lever action, ample time is given for the metal in the rivet to flow and fill the hole completely. Also an

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opportunity is given for the rivet to set before the pressure is completely released on the return stroke of the lever. This scientific distribution of power and speed, it is claimed, makes the motion particularly useful for driving cold rivets, since the motion automatically slows up during the lever action and gives the metal time to flow under full pressure, thus avoiding crystallization.

A novel feature of the machine illustrated is the flush top, which permits riveting angle connections on plate work as close up as 2 inches.

Wiegand Chain Screen Door

Everyone who has had any experience with firing a steam boiler is well aware of the inefficiency and discomfort existing whenever the fire door is thrown open either for stoking or for breaking and cleaning the fire. A solid column of cold air sweeping in at the open furnace door suddenly chills the highly heated brick work and crown sheet, causing the exposed parts of the firebox to contract on account of the immediately lowered temperature. To overcome this drawback the E. J. Codd Company, Baltimore, Md., has recently perfected and placed on the market a simple and inexpensive device, known as the Wiegand auxiliary chain door, designed to prevent the inrush of cold air into a furnace on opening the door and also to prevent the loss of heat from the furnace by radiation through the open door, consequently making the work of the firemen more endurable, as, with the furnace opening protected, he is not subjected to excessive temperatures.

The Wiegand auxiliary chain door consists of a large number of separate, freely hanging strands of small steel chain suspended from a cylinder extending across the top of the furnace door with the chains spaced as closely together as possible, thus forming a continuous sheet of chain similar to the familiar Japanese door screen. The cylinder carrying the chain screen is supported above the furnace opening in suitable brackets. When the fire door is closed this sheet of chain is rolled up on the cylinder. The act of opening the fire door automatically unrolls the chain from the cylinder and covers the furnace opening, shutting off the escape of heat and checking the entrance of cold air. The only air that can then enter the firebox must pass through the holes in the chain, which split it up into small streams, producing a better mixture with the hot gases arising from the fire bed, thereby promoting instead of hindering combustion.

An idea of the effectiveness of this device can be obtained from experiments made by placing a thermometer 10 inches in front of the furnace opening (a position usually taken by the fireman in stoking or cleaning the fire), showing that when the furnace door is open without the chain screen interposed the temperature immediately rises to about 400 degrees Fahrenheit. On covering the furnace opening with the auxiliary chain door the temperature at once falls to about 135 degrees Fahrenheit, making it possible to expose the unprotected hand anywhere in front of the screen opening without discomfort. The heat intercepted by the chains comprising the screen is returned to the furnace instead of being wasted, as any air that enters the furnace in passing through the holes in the screen takes up the heat that has been absorbed by the chains from the fire bed and carries it back into the combustion chamber.

As shown by the illustrations, this steel chain screen forms a flexible, penetrable transparent screen which does not interfere with a thorough inspection of the interior of the furnace. In fact, a better view of the fire is ob-

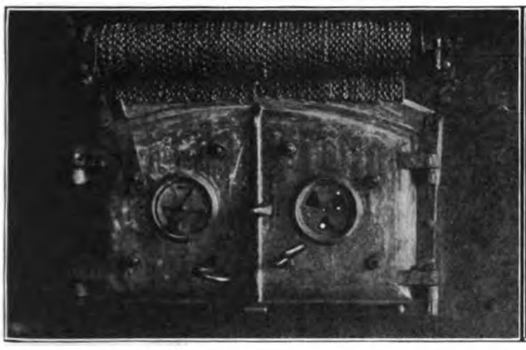

Fig. 1.—Furnace Doors Closed; Chain Screen Rolled Up

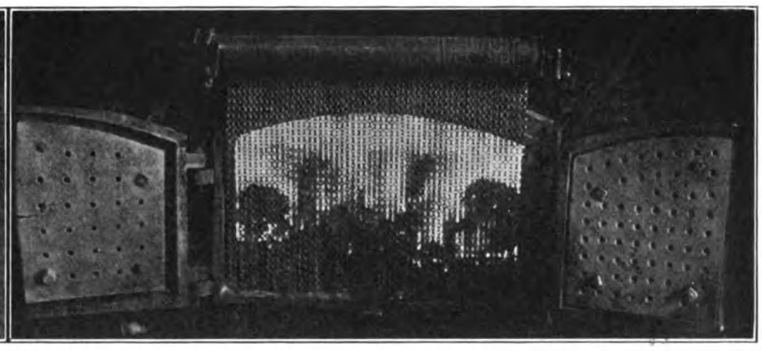

Fig. 2.—Furnace Doors Open; Chain Screen Lowered

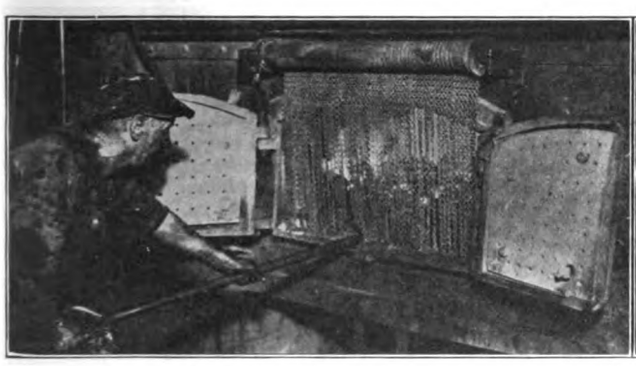

Fig. 3.—Cleaning the Fire Through the Screen

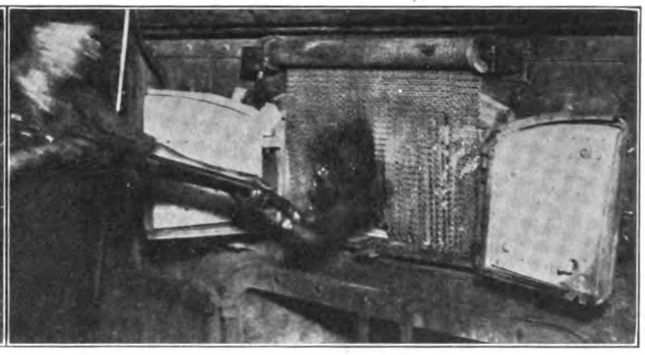

Fig. 4.—Stoking the Fire Through the Screen

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tained through the links in the chain than when the entire fire bed is exposed, as the strong glare is toned down. Furthermore, the screen offers no obstruction to handling the fireman's tools, for the flexibility and lightness of the chains enable the firemen to stoke the furnace or clean the fire directly through the screen.

The Wickes Continuous Electric Blue Printing Machine

Wickes Bros., Saginaw, Mich., has placed on the market a small, compact, electric blue printing machine which will print continuous rolls or separately cut sheets of any desired length and any widths varying from 2 inches up to and including 48 inches. The blue print paper travels over a feeding belt on an incline with the tracing, and is

Wickes Blue Printing Machine

carried to a feed roller and around a printing cylinder in which is mounted the lighting element. The blue print paper is then delivered to a light-tight storage compartment and the tracing is delivered back to the operator.

The light is obtained from a mercury vapor lamp of standard pattern which is very rich in chemical light, practically all of the energy being given out in actinic rays. The lamp requires 3½ amperes at 110 volts and is automatic in operation. The total current consumption of the machine, including the lighting element and the motor at 110 volts, is only 5 amperes.

The printing cylinder which surrounds the lighting element is composed of longitudinal and spirally-disposed wires woven right-handed at one side of the center of the machine and left-handed at the other side. This, it is claimed, gives a very desirable ironing or spreading effect to each side of the tracing, and gives an absolutely perfect contact between the tracing and the paper. The spirally-disposed wires of the cylinder offer much less actual obstruction to the light than would a glass cylinder, the distance from the light to the paper being only 2 inches around its entire circumference. No ventilating fan is necessary, as the heat from the lighting element passes off rapidly through the open grill work of bronze wires.

Personal

D. J. Lamey has been appointed second engineer of the West Kentucky towboat *Egan.*

George Armshaw has shipped from New Orleans, La., as chief engineer of the steamer *Mexicana.*

Joseph Pilaski, of New Orleans, La., has been appointed second assistant engineer of the steamer *Curry.*

William Rigny, of New Orleans, La., has been appointed first assistant engineer of the steamer *Mexicana.*

Thomas Neilson, of New Orleans, La., has been appointed chief engineer of the tank steamer *Bayway.*

Joseph Blunt of New Orleans, La., has been appointed second assistant engineer of the steamer *Mexicana.*

Robert Mosely has been appointed chief engineer of the New York State tug *Schenectady* at Watervliet, N. Y.

Charles Johnson, of New Orleans, La., has been appointed second assistant engineer of the tank steamer *Bayway.*

Thomas Fielding has been employed by the Associated Bar Pilots of New Orleans, La., to take charge of their pilot boats.

William F. Brookes has been appointed chief engineer of the steamer *Mamie D.* of the Bowie Lumber Company, New Orleans, La.

Jerome Morrow, of Sturgeon Bay, N. Y., has been appointed chief engineer of dredge *No.* 51 of the Great Lakes Dredge & Dock Company at Troy, N. Y.

Henry Stammell, formerly chief engineer of the steamer *Hudson Taylor,* will have charge of the tug *James A. Morris* on dyke work at New Baltimore, N. Y.

Charles Du Bois has been appointed chief engineer of the steam tug *Charles H. Pike,* running between Whitehall and Waterford on the New York State Barge Canal.

Joseph Vick, of Paducah, Ky., formerly chief engineer of the steamer *Oscar Barrett,* has been transferred to the steamer *Barrett,* whrre he is serving as second engineer.

Arthur Hunt, formerly of the Albany Towing Company's tugs, will be chief engineer of the steamer *Hudson Taylor* of the Central Hudson Steamboat Company from Albany, N. Y.

Arthur Robinson has been appointed chief engineer of the steamer *Du Barry,* which is now running on the Mattox Creek route from Washington, D. C., under Captain Sly's command.

William G. Emmick of Paducah, Ky., has been appointed chief engineer of the river steamer *Nashville,* succeeding Joe Vandergrift. Mr. Emmick's brother is second engineer of the *Nashville.*

Charles L. Gunn, of Paducah, Ky., has been appointed chief engineer of the West Kentucky towboat *Egan,* filling the position made vacant by the resignation of Dan Varble, formerly chief engineer of this vessel

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C. J. Tenneson has been appointed chief engineer of the steamer *Angler,* which has been placed on the excursion route between Liverpool and Washington, D. C., with Captain William Davis in command.

John Murry, formerly a well-known marine engineer, died on March 2 at Soldier's Home, Jackson county, Tennessee, aged forty-seven years. Mr. Murry was a member of the crew of the steamship *Merrimac* during the Spanish-American War.

Floyd Lounsbury, formerly chief engineer of the tug *Mabel,* Albany, N. Y., will have charge of the engine room of the steamer *Empire,* running between Albany and Troy, N. Y., during the coming season. Captain Charles Picket will be in command of the *Empire.*

J. H. Clark, recently appointed assistant general superintendent of the New York division of the Baltimore & Ohio railroad, and general superintendent of the Staten Island lines, was formerly superintendent of the floating equipment of the Baltimore & Ohio Railroad. For many years Mr. Clark has been a prominent member of the National Board of Steam Navigation.

Frank S. Martin, consulting engineer and naval architect, at 52 Beaver street, New York, has made a specialty of marine refrigerator work and is now prepared to furnish plans and specifications for all classes of refrigeration for marine service for the carrying and the storage of frozen and chilled meat, fruit, etc., and also to supervise the installation of the plants or the repairing and testing of same.

E. W. Talman, until recently chief engineer of the United States dredge *San Pedro,* has retired after fifty years' service as an engineer. Mr. Talman was born in Pennsville, N. J., in 1831, and at the age of eighteen became a machinist's apprentice with Rainey & Nafie of Philadelphia. During the Civil ar he served in the Union forces, both ashore and afloat, and at the close of the war began an eventful career as a marine engineer, which led him to many parts of the world and into many strange adventures.

W. H. Pleasants, for many years vice-president and general manager of the Ocean Steamship Company of Savannah, was recently elected president of the company. Mr. Pleasants was first connected with the Florida, Central & Peninsula Railroad Company as general freight agent in 1898. In 1900 he became general freight and passenger agent of the Ocean Steamship Company. Two years later he became traffic manager of the Seaboard Air Line, but in September of that year returned to the Ocean Steamship Company, of which he is now president.

A. H. Clement, of A. H. Clement & Company, forwarding agents of New Orleans, has been elected president of The Association for the Development of American Shipping, Inc., recently organized by a group of steamship men of New Orleans and vicinity for the purpose of encouraging the enactment and enforcement of legislation favorable to the enlargement and development of the American merchant marine. The society is also empowered to participate and assist in the promotion of the organization and operation of corporations for building, acquiring, owning or operating ships under the American flag. J. W. Cory, of Gulfport, Miss., is vice-president of the society, and George F. Taylor, formerly vice-president of the Mobile Steamship Company, Mobile, Ala., is secretary and treasurer.

George T. Cahill, chief engineer of the steel tug *Marguerite* of the Great Lakes Dredge & Dock Company, engaged in work near the State dam at Troy, N. Y., went through a thrilling experience on April 15. Two large towboats operating at the dam were caught in the eddies when the tide was running about eleven miles an hour and became unmanageable. In response to their calls for help, the tug *Marguerite* was sent to their assistance, but caught on a ledge of rocks, whirling around and capsizing on her beam's end in less than a minute. The crew all climbed to the high side and had the raft ready for escape in case the boat should be swept into deep water, but fortunately no one went overboard and the entire crew was saved. As a strange coincidence it was just ten years and ten days that Mr. Cahill was shipwrecked near the same place and the captain of the vessel was drowned.

Obituary

Morgan Robertson, inventor of the periscope, the "eye" of the submarine, and widely famed as an author and poet, did suddenly March 24.

George W. Sherwood, until recently superintendent of the lighterage department of the Mallory Steamship Company, died on April 2 at his home in Brooklyn, N. Y., at the age of seventy-one.

Professor Charles William MacCord, professor emeritus of the Stevens Institute of Technology and a noted draftsman, died recently at his residence in Hoboken, N. J., in his eightieth year. Professor MacCord was born in Dutchess county, New York, and was educated at Princeton University. He became draftsman for Captain John Ericcson in 1859 and drew the plans for the famous *Monitor,* the conqueror of the famous Confederate ironclad *Merrimac.* Professor MacCord remained with Ericcson until 1868, and after several years in private practice became professor in drafting work and designing at Stevens Institute.

John Englis, of the widely-known shipbuilding firm of John Englis & Son, at Greenpoint, N. Y., died at his home in Brooklyn on April 1 at the age of eighty-two. Mr. Englis entered the shipbuilding business at the age of seventeen in the plant established by his father at the foot of East Tenth street, Manhattan. Later he was admitted to the firm, which became known as John Englis & Son. Among the famous steamers built by this firm were the *Daniel Drew, Dean Richmond, Old Colony, Saratoga, City of Troy, C. H. Northam, Columbian, Grand Republic, Tremont, Forest City, Star of the East, Katahdin, Cambridge, Falmouth, John Brooks,* and many of the famous old-time coasting steamers, such as the *City of Mexico, City of Nerida, City of Havana, City of New York, City of Atlanta* and *City of Columbia.* The last notable steamboat built in its entirety at the Englis yards was the *Adirondack.* Mr. Englis was one of the organizers of the Main Steamship Company, was long its vice-president and general manager, and for a time its president, until it was sold to the New England Navigation Company. He was formerly president and for fifty years a director of the New Jersey Steamship Company (People's Line), between New York and Albany; vice-president and managing director of the Brooklyn Ferry Company, New York; formerly president and director of the Portland Steam Packet Company, and also a director in the International Steamship Corporation. At his death Mr. Englis was still a director in the Charleston Steamship Company, the Clyde Line, the Ward Line, the Mallory Line, the Catskill Evening Line, and in other corporations.

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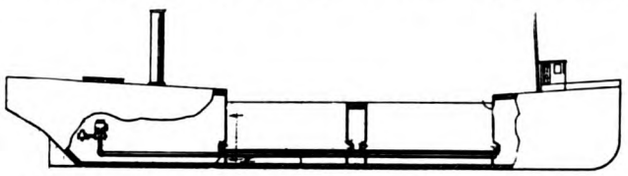
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,127,138. SAND BARGE. CHARLES C. WEST, OF MANITOWOC, WIS., ASSIGNOR TO MANITOWOC SHIP BUILDING AND DRY DOCK COMPANY, OF MANITOWOC, WIS., A CORPORATION OF WISCONSIN.

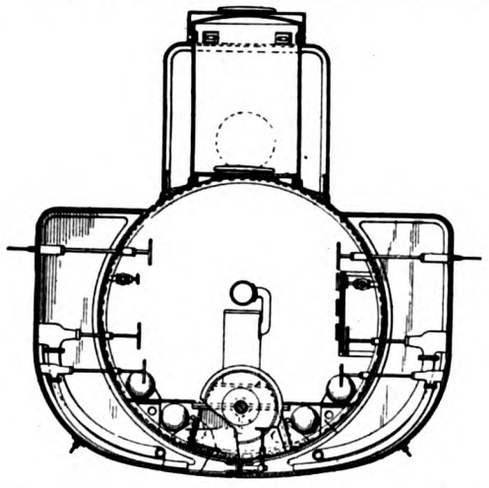
Claim 1.—A sand barge of the type wherein clam shell or similar bucket unloading devices are designed to be employed to unload the hopper contents, the combination of the sand containing hopper, a self-contained suction screening device disposed with said hopper out of the



path of travel of said unloading devices and provided with a head and an outlet opening formed in said head, and a suction creating device located adjacent said hopper and having a tubular connection leading to its suction side from the said outlet opening. Four claims.

1,127,707. SHALLOW-DRAFT SUBMARINE BOAT. FRED BROWN WHITNEY, OF WAUKEEGAN, ILL.

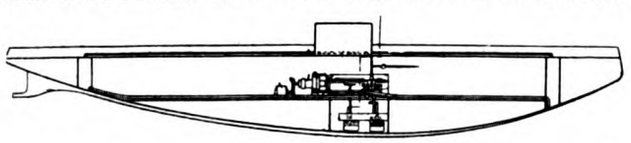
Claim 1.—A shallow-draft submarine boat, comprising an inner hull of sufficient strength to resist the pressure incident to submergence, and having a substantially cylindrical intermediate section constituting a machinery compartment and tapering end sections, and an outer hull partly surrounding said cylindrical section and spaced therefrom, the space



thus formed providing water-ballast compartments, propeller shafts journaled in the after end of said main hull having propeller wheels on their outer ends, motors having their shafts connected direct to the inner ends of said propeller shafts, dynamos located in said machinery compartment and mounted on the keel plate of said main hull, and engines also located in said compartment and on said keel-plate, each engine having its shaft connected direct to one dynamo, the shafts of said dynamos and engines being disposed in a plane substantially parallel with the longitudinal axis of the boat and below the vertical center thereof, as specified. Seven claims.

1,127,648. BALLAST-CONTROLLING APPARATUS. SIMON LAKE, OF MILFORD, CONN., ASSIGNOR TO LAKE TORPEDO BOAT COMPANY, OF MAINE, OF BRIDGEPORT, CONN., A CORPORATION OF MAINE.

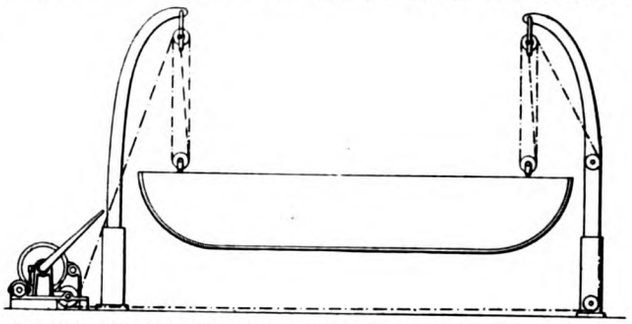
Claim 8.—The combination with a submarine boat having forward and aft trimming tanks in the bow and stern, respectively, and final adjusting tanks at the amidships section of the boat, and a valve controlled pipe



connecting said final adjusting tanks with the water of flotation, of a pump, a valve casing having a plurality of communicating passages piped to said trimming tanks and said final adjusting tanks, communicating passages piped to said pump, and a passage piped to the water of flotation, a normally open valve controlling the communication between the passages leading to the pump, and normally closed valves controlling the communications between the several passages communicating with the said tank pipes, a valve controlled vent for the said trimming tanks, a rotatable control lever pivotally mounted on said valve casing and having a horizontal member adapted for engagement with the stems of all of said valves, said lever being also adapted to operate said vent valve, substantially as and for the purpose specified. Ten claims.

1,128,656. APPARATUS FOR HANDLING LIFE-BOATS. HARRY W. BROADY, OF BAYSIDE, N. Y., ASSIGNOR TO WELIN MARINE EQUIPMENT COMPANY, A CORPORATION OF NEW YORK.

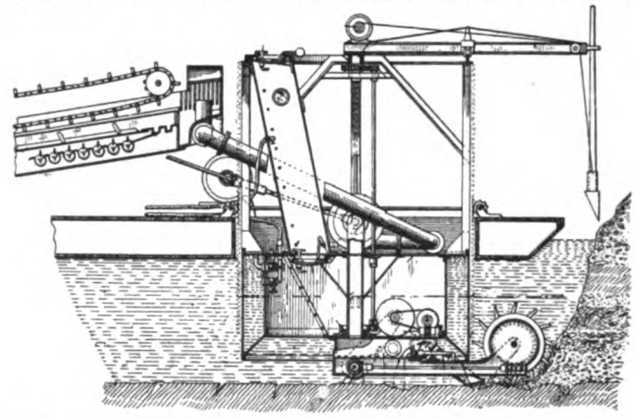
Claim 1.—Apparatus for handling lifeboats embodying therein a pair of davits, falls connected to each end of the lifeboat and to the davits, a pair of drums mounted on the vessel, one of such drums having the running part of the falls connected to ene end of the lifeboat wound thereon, and the other having the running part of the falls connected to



the other end of the lifeboat wound thereon, common means for driving and braking said drums, and interchangeable means connected to the running falls for hoisting and lowering the boat or for adjusting the lengths of the falls at opposite ends of the boat. Seven claims.

1,129,351. DREDGING APPARATUS. SIMON LAKE, OF MILFORD, CONN.

Claim 1.—In a dredging apparatus, the combination with a float and a vertically movable submergible chamber arranged in said float and open at its bottom, of a suction apparatus having a pipe extending into and toward the bottom of said chamber, a casing forming the intake of the



suction apparatus and having a swivel connection with the lower end of said pipe, means arranged within the casing and movable with it for separating and collecting the valuable material, means to move said casing horizontally, a movable intake pipe applied to said casing, and means arranged in advance of said intake pipe to loosen the material to be dredged. Six claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

10,737/1914. MARINE ENGINE GOVERNOR. G. McCLURE, 47 ST. VINCENT CRESCENT, GLASGOW, SCOTLAND.

Claim.—The governor consists essentially of two parts, namely, a steam cylinder which acts directly by means of a piston, rod and lever on the throttle valve, or an electrical arrangement of magnets or electro motors may be employed to control the valve, a water box in which a diaphragm operating the steam valve of the steam cylinder is fitted, which diaphragm is in direct connection with the sea on both sides, the under side with the inlet at the forward end and the upper side with the inlet at the after end of the ship any movement of the diaphragm is due to the difference of pressure at these parts. By utilising the pressure due to the hydraulic head of the wave approaching the stem of the ship, the throttle valve is closed in sufficient time to anticipate the racing which would occur when the above wave passes the center of buoyancy and raises the stern and the propeller partly out of the water.

14,191/1913. IMPROVED EQUIPMENT FOR NAVIGATIONAL PURPOSES. KELVIN & JAMES WHITE, LTD., AND ANOTHER, GLASGOW, SCOTLAND.

This invention has for its primary object to increase the utility of the mariner's compass when used in conjunction with the azimuth mirror, and of a telemeter, for determining the position occupied by a ship in relation to a landmark, and also, if desired, the extent in degrees by which the ship's course must be varied so that the ship may pass a landmark abeam at a desired distance. The determination of the position of the ship in relation to a landmark involves the measurement by means of the "log," of the distance traveled by the ship between two stations, or positions at which bearings of the object in relation to the ship's course have been taken, and a simple mental calculation, the factors of which are furnished by the log and by a cotangent scale applied to the compass, the characteristic feature of which scale is that the numerical value assigned to each marking is proportional to the cotangent of the angular displacement of the particular marking from the lubber line of the compass.

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